A Project/Dissertation Review-3Report

On

COVI-INDIA ANALYSIS

Submitted in partial fulfillment of the

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INDIA

COVI-INDIA ANALYSIS

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Words fall short to express our deep sense of gratitude towards them all who have imparted their valuable time, energy and intellect towards the beautification of our Analysis project entitled as, “Covi-19 Analysis India”.

It gives us a great pleasure in presenting this report. Its justification will never sound good if we do not express our vote of thanks to our guide Prof. **Mrs.Heena Khera** without whose help our Analysis & its thesis would have neither began nicely nor would have reached a fine ending.

Never can we forget the hard labor & pain taken by our H.O.D. & All Professors who’s hard – working nature, sophisticated teaching & guidance helped us framing & building this project & lastly we are also thankful to www.covid19india.org and their Research Team for being directly or indirectly helpful to us to build our project to be presented to the college.

Project Guide Signature : - **Student Signature:-**

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ABSTRACT

There has been an outbreak of corona pandemics around the different parts of the world. It is seen as a major concern for health and life issue of people of different country. India is facing very much trouble in controlling the outbreak of the impact of virus in different part of India. Though being very late but the good news is that we have taken some control over spread of the virus. With the help of this project we will be making a website which will help us to tell the effect of all the variants that has been found in our country. It will not only deal with impact on the whole but also to the states that has been effected and by how much. We will do this with the help of data obtained from the sources (till 9-10 April) with the help of state units of our country and Health Ministry and Family, Government of India, this study presents various trends and patterns.

Basically we will do what is that we will prepare a website which will help us with the analysis of the cases of the different variants in our country. Our main Web page will consists of map of India with different states with their covid cases sensitiveness. When we click over those states it will show all the Covid Cases of all the variants that has been found in India (Alpha Variant and Delta Variant). Thus this is the logic behind our project we will use database of covid India cases from Kaggle. Thus it will help lot to increase the project physical view.

So, basically we will use HTML5(Hyper Text Mark-Up Language which will build the skeleton of our website. After we are done with our HTML we will go for some styling using CSS (Cascading Style Sheet). CSS will generally add some good design to our website and will help us to make it interactive. There comes Bootstrap which contains preloaded styling which we have to just add to our HTML part which will include those styles to our web page. We will use Java Script and a database which will contain the Covid-19 information. We will use Kaggle database.

This research paper basically focused to show the Covid-19 cases like death recoveries, active cases in the different part and sub-part of our country.

CHAPTER-1
Introduction

On 31 December 2019, the first reported case in the COVID-19 outbreak was reported in Wuhan, China. The first case outside of China was reported in Thailand on 13 January 2020 . Since then, this ongoing outbreak has now spread to more than 50 other countries . WHO declares COVID-19 outbreak as a Public Health Emergency of International Concern (PHEIC) by WHO on 30 January 2020 . There are over 76,000 cases of confirmed COVID-19 worldwide asOf 20 February.COVID-19 is caused by a new type of corona virus which was previously named 2019-nCoV by the World Health Organization (WHO). It is the seventh member of the corona virus family, together with SARS-nCoV, that can spread to humans . The symptoms of the infection include fever, cough, shortness of breath, and diarrhea. In more severe cases, COVID-19 can cause pneumonia and even death . The incubation period of COVID-19 can last for 2 weeks or longer. During the period of latent infection, the disease may still be infectious. The virus can spread from person to person through respiratory droplets and close contact .

One of the most important steps in stopping the COVID-19 pandemic is influencing mass behavior change for citizens to take appropriate, swift action on mitigating infection and human-to-human contact. Government officials at all levels have advocated misinformed practices such as dining out or participating in outdoor gatherings that have contributed to amplifying the curve rather than flattening it. At time of writing, the result of poor crisis emergency risk communication has led to over 32.9M US citizens testing positive, 2-20X more are likely untested, and over 584K deaths. The need to influence appropriate behavior and mitigation actions are extreme: The US has shot up from untouched to become the 6th most infected nation. Almost all States/UTs of the country are affected by COVID-19. Given the seasonal pattern of epidemic prone diseases observed every year in our country, it diseases like Dengue, Malaria, Seasonal Influenza, Leptospirosis, Chikungunya, Enteric fever, etc. can not only present as a diagnostic dilemma but may co-exist in COVID cases. This poses challenges in clinical and laboratory diagnosis of COVID , and have a bearing on clinical management and patient outcomes. Almost all States/UTs of the country are affected by COVID-19. Given the seasonal pattern of epidemic prone diseases observed every year in our country, it diseases like Dengue, Malaria, Seasonal Influenza, Leptospirosis, Chikungunya, Enteric fever, etc. can not only present as a diagnostic dilemma but may co-exist in COVID cases.

Scope
The scope of this document is to provide clear guidelines on prevention and treatment of co-infections of COVID with diseases like Dengue, Malaria, Seasonal Influenza (H1N1), Leptospirosis, Chikungunya etc.

Clinical features
As per the World Health Organization (WHO) case definition, a COVID case may present with: Acute onset of fever AND cough; OR Acute onset of ANY THREE OR MORE of the following signs or symptoms: fever, cough, general weakness/fatigue, headache, myalgia, sore throat, coryza, dyspnoea,anorexia/nausea/ vomiting, diarrhoea, altered mental status. This case definition, although sensitive, is not very specific. Seasonal epidemic prone diseases, as cited in the foregoing paragraphs may all present as febrile illness, with symptoms that mimic COVID-19. If there is a co-infection, then apart from the febrile illness there may be constellation of signs and symptoms that may lead to difficulty in diagnosis. A comparative analysis of disease onset, symptoms, signs, warning signs, complications and diagnosis is given at **Annexure**.

1.1Formulation of problem

A high index of suspicion must be maintained for epidemic prone diseases (e.g. Dengue, Malaria, Chikungunya, Seasonal influenza, Leptospirosis) prevalent in a particular geographic region during monsoon and post-monsoon seasons. Bacterial co-infections must also be suspected in moderate or severe cases of COVID-19 not responding to treatment.

Malaria/Dengue: It must be borne in mind that malaria/dengue can coexist with other infections, and thus confirmation of malaria/dengue infection does not rule out the possibility of the patient not suffering from COVID-19. Similarly, a high index of suspicion of malaria/dengue must be there when a fever case is diagnosed as COVID-19, particularly during the rainy and post rainy season in areas endemic for these diseases.
Seasonal Influenza: Both COVID-19 and Seasonal Influenza present as Influenza Like Illness (ILI)/SARI, hence all ILI/SARI cases in areas reporting COVID-19 cases must be evaluated and tested for both COVID-19 and Seasonal Influenza, if both viruses are circulating in population under consideration.

Chikungunya: Chikungunya presents with acute onset of moderate to high grade continuous fever and malaise followed by rash, myalgia and arthralgia. Respiratory failure may ensue in late stages. Co-infection with COVID-19 may be suspected in Chikungunya endemic areas, in the months of monsoon.

Leptospirosis: Leptospirosis apart from it presenting as febrile illness, has also the tendency to manifest as acute respiratory illness, leading to respiratory distress and shock. In areas where Leptospirosis is known to cause outbreaks during monsoon/ post monsoon, the possibility of co infection should be considered.

Scrub Typhus: Scrub typhus is known to be prevalent in foothills of Himalayas viz Jammu & Kashmir, Himachal Pradesh, Sikkim, Manipur, Nagaland, Meghalaya, etc. However, in recent past, scrub typhus outbreaks have also been reported from Delhi, Haryana, Rajasthan, Maharashtra, Uttarakhand, Chhattisgarh, Tamil Nadu and Kerala. The clinical picture consists of sudden high-grade fever, severe headache, apathy, myalgia and generalized lymphadenopathy. A maculopapular rash may appear first on the trunk and then on the extremities and blenches within a few days. The patients may develop complications that include interstitial pneumonia (30 to 65% of cases), meningoencephalitis and myocarditis. Scrub typhus infection may co-exist with COVID-19.

Bacterial infections: Few patients with COVID-19 experience a secondary bacterial infection. In such cases, empiric antibiotic therapy as per local antibiogram needs to be considered. Despite the possibility of above mentioned co-infections, in present times of the pandemic, approach to diagnosis for COVID-19 essentially remains the same. Testing protocol as per MoHFW/ICMR guidelines will be followed. However, in addition, further tests for a likely co-infection will also be undertaken, whenever suspected.

Diagnostics

While each of these infections are antigenically distinct with specific serological responses, yet in the eventuality of co-infections, cross-reactions (resulting in false-positive /false negative results) cannot be totally ruled out, especially if the testing kits used are not having requisite sensitivity and specificity. Hence the tests recommended by ICMR (for COVID-19) and that recommended by the concerned programme divisions (NVBDCP for vector borne diseases [Malaria, Dengue, Chikungunya]) and NCDC (Seasonal Influenza, Leptospirosis, Scrub Typhus)] needs to be followed. Availability of rapid diagnostic kits for malaria, dengue, scrub typhus should be ensured in such COVID treatment facilities. The table below summarizes the various (confirmatory) test to be undertaken for possible coinfections.

Laboratory Testing: Co-infection of COVID 19 with other seasonal epidemic prone diseases Diseases Tests Sample

Dengue NS1 antigen ELISA or RT PCR: For < 5 days of illness IgM capture ELISA (MAC-ELISA): For >5 days of illness Blood/Serum Chikungunya Early disease: RT PCR After first week of illness: IgM capture ELISA Blood/Serum H1N1 Acute phase: RT PCR Naso/Oropharyngeal swab COVID 19 Acute phase: RT PCR Nasopharyngeal/ Oropharyngeal swab Malaria RDT (bi-valent both Pf/Pv detection) Quality microscopy for slide positivity confirmation Blood Leptospirosis In endemic areas: IgM ELISA and MAT tests Non-endemic areas: IgM ELISA followed by MAT test for confirmation Scrub Typhus Detection of IgM antibodies by Weil-Felix Test (WFT) Enzyme linked Immunosorbent assay (ELISA) Serum Bacterial co-infections Gram stain and culture, Blood culture Sputum/Bronchial aspirate/Blood

Case Management

Management of co-infection of COVID-19 with dengue, Influenza and bacterial co-infections may however be challenging and are dealt with in greater detail here.

Management of COVID-19 and Dengue co-infection

Pathogenesis

Dengue Fever and COVID-19 share many pathogenic and clinical features which might make it very difficult to differentiate the two infections (1). The phenomenon of ADE (Antibody Dependent Enhancement) has been described for both dengue virus as well as for SARS-CoV-2 virus resulting in escalation in degree of infectionand number of complications. Both being RNA viruses they share certain common features in pathogenesis, eventually leading to subsequent cytokines and chemokine release and also affecting the integrity of the vascular endothelium leading to vasculopathy, coagulopathy and capillary leak. Various mechanisms can explain the signs and symptoms observed in co-infected patients but most will have the following, (i) Antibody-dependent enhancement (ADE), (ii) Cytokine Storm, (iii) Vasculopathy and (iv) Coagulopathy.

Clinical Features

The clinical features of both the infections are overlapping, both present as acute febrile illness of short duration and may have thrombocytopenia and shortness of breath, although respiratorysymptoms are more common in COVID-19 and bleeding manifestations more common in Dengue. Routine testing for both diseases shows leucopenia or normal leucocyte count. Decrease in platelet count which is a defining feature of dengue infection but can also be seen in significant number of covid cases. There are reports in literature, where dengue serology was positive initially and later on, it was found that cases were positive by RT-PCR for COVID-19 thereby suggesting that dengue serology can be falsely positive in COVID-19 patients. Therefore, there is a need to rely on more specific tests for each disease like throat swab RT-PCR for COVID-19 and ELISA based Dengue NS1 Antigen or serology test for dengue diagnosis. Serum sample for NS1 antigen within first 5 day of onset of fever were negative in above study suggesting that positive dengue serology was more likely to be false positive result and not co-infection. Hence, one needs to be careful while making diagnosis of co-infection. There are now enough evidences to support that severe dengue is associated with cytokine storm and high levels of various circulating cytokine are associated with poor outcome in most cases. COVID- 19 infects alveolar epithelial cells leading to pneumonia and ARDS, it also infects monocytes/macrophages leading to cytokine storm associated with multi organ failure and death. This cytokine storm seen in severe cases has led to increased use of steroids and other immunosuppressive therapy in moderate to severe cases.

Both COVID-19 and Dengue infection are accompanied by coagulopathy and vasculopathy with coagulopathy being predominant in formal leading to widespread use of Low Molecular Weight Heparin (LMWH). There have been numerous evidences to suggest the increased burden of thrombosis in COVID-19 based on which recommendations have been made for the use of LMWH in moderate to severe cases. But in the presence of Dengue co-infection which is usually accompanied by thrombocytopenia and increased risk of bleeding , the use of LMWH becomes a challenging issue. Similarly, because of increased capillary leak and increased third space fluid loss, fluid administration which forms the cornerstone in management of dengue might not be recommended with clarity as conservative fluid administration has been recommended for COVID-19 in absence of shock.

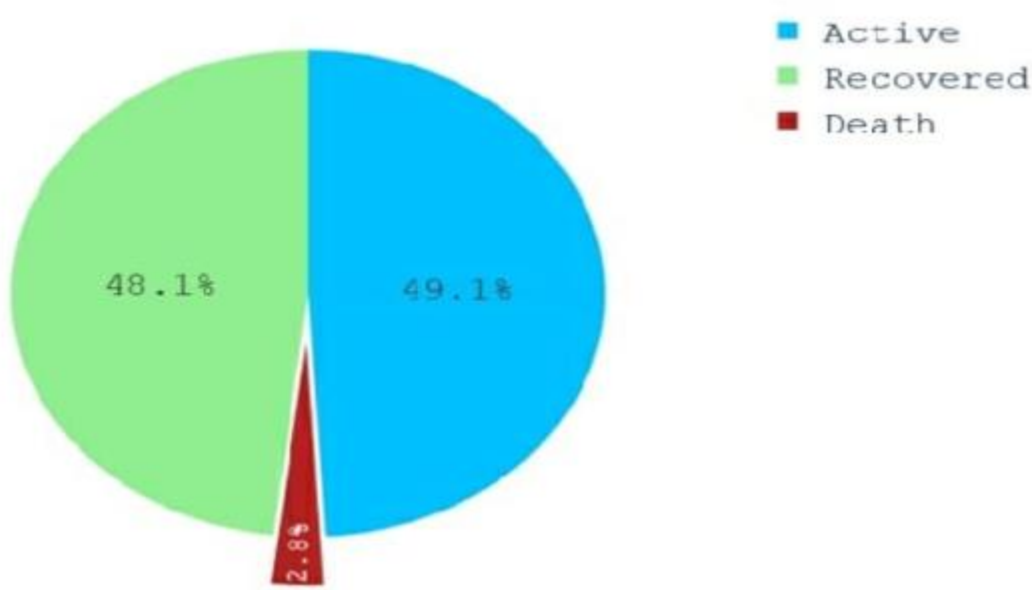
Clinical management consideration for Dengue and COVID-19 co-infection

Following are some general measures to followed in case of Dengue and COVID-19 co-infection:

Co-infection should be ruled out when suspected with proper diagnostic method at the early stage to initiate proper specific management to reduce morbidity and mortality. Strengthening at the primary health care level is the key to manage dengue through early clinical diagnosis and recognition of warning signs for severity of Dengue (such as abdominal pain or tenderness, persistent vomiting, clinical fluid accumulation, mucosal bleed, lethargy or restlessness, liver enlargement >2 cm, and increase in haematocrit). Mild to moderate Dengue and COVID co-infected patient should be monitored closely preferably at hospital, as they may rapidly progress to severe stage therefore they should be referred to higher centre at the early stage by recognizing warning signs. At the same time, all secondary and tertiary level hospitals should be prepared to manage severe dengue and COVID cases.

CHAPTER-2
Literature Survey

Corona virus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome corona virus 2 (SARS-CoV-2). It was first identified in December 2019 in Wuhan, China, and has resulted in an ongoing pandemic. The first case may be traced back to 17 November 2019. As of 8 June 2020, more than 6.98 million cases have been reported across 188 countries and territories, resulting in more than 401,000 deaths. More than 3.13 million people have recovered.The virus is primarily spread between people during close contact, most often via small droplets produced by coughing, sneezing, and talking. The droplets usually fall to the ground or onto surfaces rather than travelling through air over long distances. Less commonly, people may become infected by touching a contaminated surface and then touching their face. It is most contagious during the first three days after the onset of symptoms, although spread is possible before symptoms appear, and from people who do not show symptoms The virus is primarily spread between people during close contact, most often via small droplets produced by coughing, sneezing, and talking. The droplets usually fall to the ground or onto surfaces rather than travelling through air over long distances. Less commonly, people may become infected by touching a contaminated surface and then touching their face. It is most contagious during the first three days after the onset of symptoms, although spread is possible before symptoms appear, and from people who do not show symptoms.



PANDEMIC :-

The COVID-19 pandemic, also known as the corona virus pandemic, is an ongoing pandemic of corona virus disease 2019 (COVID-19), caused by severe acute respiratorysyndrome corona virus 2 (SARS-CoV-2). The outbreak was first identified in Wuhan, China, in December 2019. The World Health Organization declared the outbreak a Public Health Emergency of International Concern on 30 January, and a pandemic on 11 March.A global coordinated effort is needed to stop the further spread of the virus. A pandemic is defined as "occurring over a wide geographic area and affecting an exceptionally high proportion of the population." The last pandemic reported in the world was the H1N1 flu pandemic in 2009.

Corona viruses are important human and animal pathogens. At the end of 2019, a novel corona virus was identified as the cause of a cluster of pneumonia cases in Wuhan, a city in the Hubei Province of China. It rapidly spread, resulting in an epidemic throughout China, followed by an increasing number of cases in other countries throughout the world. On 30th January 2020 India recorded its first COVID-19 case in state of Kerala. It was a student who had travel history to china. And till the start of June India has over 200 thousand confirmed cases.

Almost all of the data we compile is taken directly from the websites of state/territory public health authorities. When data is missing from these websites, we sometimes supplement available numbers with information from official state social media accounts or from press conferences with governors or other state authorities.

Individual state/territory data pages such as Wyoming's, all of which are accessible from our main data page, include a link at the top of the page to the "Data sources and screenshots" for that state as well as a link to the "Notes, data anomalies, and official cautions" page for that state.

WHO and Ding Xiang Yuan, a website authorized by the Chinese government. The sites reported confirmed COVID-19 cases, as well as recovered and deaths for affected countries and regions. Details on how our team fetched the data is in Section.

PROBLEM STATEMENT:

In this project we dived deep into 'What does data say about Covid-19 situation in India?'.

And with available data we came up with some observations and conclusions.

This analysis mainly focuses on:

- ✔ What is the current COVID-19 situation in India?
- ✔ State-wise comparison.
- ✔ What could be the reasons behind cases clusters found in India.

DATA SOURCES

For the COVID-19 data we have scrapped https://api.covid19india.org which is a volunteer-driven, crowd sourced database for COVID-19 stats & patient tracing in India .

For facts and information we have referred www.wikipedia.com and www.twitter.com.

Specific therapeutic considerations

Points related with specific therapeutic options and their use in cases with co-infection:

❒

Fluid Therapy – Fluid therapy to be given in co-infection cases depends on hemodynamic status of patient and degree of severity. One may follow national guidelines for clinical management of dengue fever for most co-infection cases. It is only in the presence of SARI with COVID-19 that we need to be careful with aggressive fluid administration as it leads to worsening of oxygenation. Close clinical monitoring of fluid status is required in such cases. Aggressive fluid resuscitation is recommended for COVID-19 patients in shock for initial resuscitation.

LMWH – LMWH is being used and has been included in the National guidelines for the management of moderate to severe covid-19 cases as it is associated with increased thrombosis. Once the platelet count decreases to less than 1 lakh we need to be very careful with the use of LMWH and it may be withheld based on clinical condition of the patient. Decision to administer LMWH and the dosage for the same should be based on close monitoring with D-dimer measurements. In any case of co-infection with active bleeding, LMWH needs to be stopped immediately.

Use of Corticosteroids – Steroids specially Dexamethasone have recently been shown to be effective in severe covid-19 cases and have been recommended for the same. Dengue being a viral illness, it's course won't be affected much. Hence, use of steroids can be continued as per COVID-19 management guidelines.

Tocilizumab –To be used as per national management guidelines for COVID-19 management.

Antivirals – To be used as per COVID-19 management guidelines.

Other supportive management to be continued as per the current guidelines.

Management of Seasonal influenza and COVID co-infection

Co-infection with SARS-CoV-2 and other respiratory viruses has been described in a number of studies. Most prominent among these are Respiratory Syncytial Virus, Enteroviruses and Influenza A virus. With the approaching winter season, the seasonal Influenza cases may show an upward trend, and there could be cases of coinfection with COVID-19.

Pathogenesis

COVID-19 and Influenza share many pathogenic feature. Both diseases involve the respiratory system, manifesting widely from ILI to SARI. Both diseases cause pneumonitis. The histopathological manifestation of Interstitial inflammation and diffuse alveolar damage and intraalveolar edema followed by fibrin deposition, hyaline membrane, and leukocyte infiltration of the alveolar septa are seen in both COVID and Influenza. The radiological appearance is not of much help either as both diseases may have presence of opacities or consolidations. Both being RNA viruses they share certain common features in pathogenesis, eventually leading to subsequent cytokine release and acute respiratory distress syndrome.

Diagnosis

Whenever suspected, especially in areas reporting seasonal Influenza cases, samples should also be sent and tested for SARS-CoV-2 and Influenza.

Clinical Features

The clinical features of both the infections are overlapping, both present as acute febrile illness of short duration and may have fever, cough and shortness of breath. Similarly, laboratory investigations are also not very helpful in differentiating between the two, both show leucopenia or normal leucocyte count. Co-infection should be ruled out when suspected with proper diagnostic method at the early stage to initiate proper specific management to reduce morbidity and mortality.

Specific therapeutic considerations

Points related with specific therapeutic options and their use in cases with co-infection:

The specific treatment as provided in the clinical management protocol of COVID needs to be followed, as per severity of the disease.

- **In addition to COVID management, for the treatment of influenza, Oseltamivir needs to be administered in the prescribed dosages.**

- In case of an outbreak of Seasonal Influenza outbreak, Oseltamavir blanket therapy should be considered in all patients of COVID-19.

Other supportive management to be continued as per the current guidelines.

Management of Bacterial co-infections with COVID

Evidence shows that small proportion of COVID-19 patients may have coinfection with bacteria. Patients with community-acquired co-infections and hospital-acquired superinfections had worse outcomes. A recent systemic review on co-infections in people with COVID-19 has found that the commonly associated pathogens in such cases are Mycoplasma pnuemoniae, Psuedomonas aeroginosa, Hemophilus influenzae, Klebsiella pneumoniae etc.

The occurrence of healthcare associated infections like hospital acquired pneumonia (particularly in ICU settings), urinary tract infection, skin/soft tissue infection, abdominal infections, etc.) need to be considered.

Antibiotics should not be prescribed routinely unless there is clinical suspicion of a bacterial infection. Consider empiric antibiotic therapy as per local antibiogram. For COVID-19 patients with severe disease, also collect blood cultures, ideally prior to initiation of antimicrobial therapy.

Management of Malaria and COVID-19 co-infection

Pathogenesis

Malaria is a potentially life-threatening parasitic disease caused by a protozoan having four types:

Plasmodium vivax (P. vivax), Plasmodium falciparum (P. falciparum), Plasmodium malariae (P. malariae) and Plasmodium ovale (P. ovale). It is transmitted by the infective bite of Anopheles female mosquito. Man develops disease after 10 to 14 days of being bitten by an infective mosquito. Two types of parasites of human malaria, Plasmodium vivax (Pv), P. falciparum (Pf), are commonlyreported from India. Inside the human host, the parasite undergoes a series of changes as part of its complex life cycle. The parasite completes life cycle in liver cells (pre-erythrocytic schizogony) and red blood cells (erythrocytic schizogony). Infection with P. falciparum is the deadliest form of malaria.

Diagnosis

Diagnosis of malaria may be made by the use of RDT (bivalent) or microscopic examination of the blood smear. Early diagnosis and prompt initiation of treatment, as per national guidelines, is the key in preventing the progression of uncomplicated malaria to severe forms which can be fatal. In the current scenario, in endemic areas, all fever cases should be tested for malaria using RDT kits.

Clinical Features

Typically, malaria produces fever, headache, vomiting and other flu-like symptoms. The parasite infects and destroys red blood cells resulting in easy fatigue ability due to anemia, fits/convulsions and loss of consciousness. Parasites are carried by blood to the brain (cerebral malaria) and to other vital organs. Malaria in pregnancy poses a substantial risk to the mother, the fetus and the newborn infant. Pregnant women are less capable of coping with and clearing malaria infections, adversely affecting the unborn fetus.

Specific therapeutic considerations

Prompt malaria case management is very important for preventing serious cases and death due to malaria.

Plasmodium vivax (Pv) cases should be treated with Chloroquine for three days (25 mg/kg body weight divided over three days i.e. 10 mg/kg on day 1, 10 mg/kg on day 2 and 5 mg/kg on day 3) and Primaquine (0.25 mg/kg body weight daily for 14 days). Primaquine is used to prevent relapse but is contraindicated in pregnant women, infants and individuals with G6PD deficiency. Plasmodium falciparum (Pf) cases should be treated with ACT (Artesunate 3 days + SulphadoxinePyrimethamine 1day) @ Artesunate 4 mg/kg body weight daily for 3 days plus Sulfadoxine (25 mg/kg body weight) and Pyrimethamine (1.25 mg/kg body weight) on day 1. This is to be accompanied by single dose of Primaquine (0.75 mg/kg body weight) preferably on day 2. However, considering the reports of resistance to partner drug SP In North-Eastern States, the Technical Advisory Committee has recommended to use the co-formulated tablet of Artemether-Lumefantrine (ACT-AL) in North-Eastern States (Not recommended during the first trimester of pregnancy and in children weighing <5 kg). For details of treatment of uncomplicated and complicated malaria in certain endemic areas, special population groups (pregnancy, children etc.)All healthcare providers should also follow the NVBDCP National Guidelines for treatment of malaria **.**

Specific therapeutic considerations

All clinically suspected leptospirosis patients in Leptospira endemic area during rainy season should be given presumptive treatment of leptospirosis i.e. Tab. Doxycycline 100 mg twice daily for 7 days.

Note: In children less than 6 years 30 to 50 mg/kg/day of Cap. Amoxycillin/Cap. Ampicillin should be given in divided doses 6 hourly for 7 days. Diagnosis and clinical management of leptospirosis in community setting should be in accordance with national guidelines for prevention and control of leptospirosis (available at: https://www.ncdc.gov.in/linkimages/Leptospirosis1232331086.pdf)

Management of Scrub Typhus and COVID-19 co-infection

Pathogenesis

Scrub typhus is transmitted by the mite Leptotrombidium deliense. The vector mites inhabit sharply demarcated areas in the soil where the microecosystem is favourable (mite islands). Human beings are infected when they trespass into these mite islands and are bitten by the mite larvae (chiggers). Scrub Typhus causes perivasculitis of the small blood vessels. O tsutsugamushi stimulates phagocytosis by the immune cells, and then escapes the phagosome. Scrub typhus may disseminate into multiple organs through endothelial cells and macrophages, resulting in the development of fatal complications.

Diagnosis

Scrub typhus may be diagnosed in the laboratory by: (i) isolation of the organism (ii) serology (iii) molecular diagnosis (PCR). Several serological tests are currently available for the diagnosis of rickettsial diseases like Weil-Felix Test (WFT), Indirect Immuno-flourescence (IIF), Enzyme linked Immunosorbent assay (ELISA) etc.

Although many techniques have been used successfully for rickettsial sero diagnosis, rela-tively few are used regularly by most laboratories. BSL-3 Lab is not required for performing serological tests. Enzyme linked Immunosorbent Assay (ELISA): ELISA techniques, particularly immunoglobulin M (IgM) capture assays, are probably the most sensitive tests available for rickettsial diagnosis, and the presence of IgM antibodies, indicate recent infection with rickettsial diseases. In cases of infecton with O. tsutsugamushi, a significant IgM antibody titer is observed at the end of the first week, whereas IgG antibodies appear at the end of the second week.

Molecular diagnosis (PCR) - For PCR, blood sample is collected in tubes containing EDTA or sodium citrate. However, blood clot, whole blood or serum can also be used for the detection of O. tsutsugamushi, R. rickettsii, R. typhi and R. prowazekii organisms by PCR test.

Clinical Features Patients with scrub typhus may present early or later in the course of their disease. Inoculation through the chigger bite is often painless and unnoticed. A small painless papule initially appears at the site of infection and enlarges gradually. An area of central necrosis develops and is followed by eschar formation. The eschar (if present) is well developed at the initiation of the fevers, which may drive the patient to seek medical attention. The incubation period lasts 6-20 days (average, 10 days). After incubation, persons may experience headaches, shaking chills, lymphadenopathy, conjunctival infection, fever, anorexia, and general apathy. The fever usually reaches 40-40.5°C (104-105°F).

Specific therapeutic considerations

If scrub typhus is suspected with COVID, treatment with Doxycycline (@ 200 mg/day in two divided doses for duration of 7 days) or Azithromycin (@ 500 mg in a single oral dose for 5 days) should be administered.

Management of the individual complications should be done as per the existing practices.

7. Early warning signs

If the patient is in a primary care setup, the following criteria should be monitored to assess patients clinical progress. Early warning signs for referral to higher centre are:
Altered Mental Status (AVPU) Systolic blood pressure:

Altered Mental Status (AVPU)
Systolic blood pressure: <90mmHg or <20% of baseline inhypertensive patients ❒
Heart Rate/ Pulse Rate: <50 or >120 bpm ❒
SpO2: <94 % on room air ❒
Respiratory Rate: <10 or >30 bpm ❒
Temperature: persistently >38ºC ❒
Urine Output: <0.5 ml/Kg/Hr for consecutive2 hrs ❒
Spontaneous bleeding/ haematuria ❒
Platelet count <50.000/cumm

Prevention

Even though the basic preventive strategies of COVID-19 and seasonal influenza are different from diseases discussed in this document, it is desirable that there is synergy in the prevention of these diseases. The States must make use of their resources effectively as staff is also diverted to provide COVID-19 response. This can be achieved by combining prevention activities.

Integrated surveillance: It must be ensured that IDSP networks are strengthened to include surveillance of COVID-19 cases besides for dengue, malaria, chikungunya, leptospirosis, scrub typhus, seasonal influenza to maximize the use of resources.

Basic preventive measures for COVID-19 and seasonal influenza, like avoiding large gatherings, maintaining physical distance, hand hygiene and cough etiquette must be ensured at all times.

Vector control: Source reduction of mosquito breeding sites and adult control measures should be implemented in areas affected by or at risk of these diseases, especially in and around treatment facilities.

Use of approved insect repellents and ITN/LLINs is affective against vector borne diseases including scrub typhus.

CHAPTER-3

Functionality/working of project

Languages Description

1. HTML

- Hyper Text Markup Language.
- It is a simple coding language that is used for creating website pages.
- The structure of web page is defined using HTML.
- The version of HTML that we will use for this project is HTML5.
- HTML consists of series of tags and attributes. Each of them has some specific meaning.
- What to display on screen? This is what our HTML responds to.
- There are separate elements for each section with specific name which makes it very interactive.

Example:

```
<!DOCTYPE html>
<html>
<head>
<title>Covi-India Analysis</title>
</head>
<body>
<h1>This is my heading </h1>
<p>This is my paragraph </p>
</body>
</html>
```

2.CSS

- Cascading Style Sheet.
- How elements are to be displayed on the screen is done using CSS .
- CSS is generally used for adding some live to our web page make it stylish and attractive rather than simple HTML web page.
- Styleing can be done inside our HTML elements directly but that’s not preferred in today’s time .
- External stylesheets can also be attached to our HTML code in head section.

Example:

```css
body {
background-color: blue;
}
h1 {color: black;
text-align: center;
}
p {
font-family: arial;
font-size: 20px;
}
```

3. JavaScript

JavaScript is the most popularly used language nowadays. Being a server side language it also does the work for client side language which is proved to be very useful for making our web page interactive . Generally while designing a web page the structure part is given by HTML and styling part is given by CSS and adding interactive part to our website is done using this language which is JavaScript.

Framework Description

1. Bootstrap

- Bootstrap is commonly used framework which does a part of already written styling.
- It is easier to use you just have to attach the link in or HTML and you can use the pre-defined codes.
- All design based templates for tables, button, navbar, hamburger styling is provided by this Bootstrap framework. It also includes many other JavaScript plugins.
- This framework saves your time for styling which earlier you have to do to make our webpage look attractive.

2. jQuery

jQuery is a most commonly used JavaScript library. It follows a moto "write less do more". jQuery saves our time by simply including the part of JavaScript code into our webpage coding part. jQuery basically several lines of codes of JavaScript and combine them into methods such that you can use them with call of single function. Lot of complicated things of JavaScript (AJAX calls and DOM manipulation).Now, let's look through the jQuery features:

- HTML/DOM manipulation
- CSS manipulation
- HTML event methods
- Effects and animations

- AJAX
- Utilities

Problem Formulation

The aim of this project is basically designing a website which will show the covid variant cases with most recovered most deaths. It will firstly on its home page will contain a map of India with total cases that have been there. Also it will show the current active cases, the number of recovered cases and number of deaths. It will show all the variants in the form of huge waves. The alpha variant that was the first wave and the devasting **Languages Description**

1. HTML

- Hyper Text Markup Language.
- It is a simple coding language that is used for creating website pages.
- The structure of web page is defined using HTML.
- The version of HTML that we will use for this project is HTML5.
- HTML consists of series of tags and attributes. Each of them has some specific meaning.
- What to display on screen? This is what our HTML responds to.
- There are separate elements for each section with specific name which makes it very interactive.

Example:

```
<!DOCTYPE html>
<html>
<head>
<title>Covi-India Analysis</title>
</head>
<body>
<h1>This is my heading </h1>
<p>This is my paragraph </p>
</body>
</html>
```

2.CSS

- Cascading Style Sheet.
- How elements are to be displayed on the screen is done using CSS .
- CSS is generally used for adding some live to our web page make it stylish and attractive rather than simple HTML web page.
- Styleing can be done inside our HTML elements directly but that's not preferred in today's time .
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Problem Formulation
The aim of this project is basically designing a website which will show the covid variant cases with most recovered most deaths. It will firstly on its home page will contain a map of India with total cases that have been there. Also it will show the current active cases, the number of recovered cases and number of deaths. It will show all the variants in the form of huge waves. The alpha variant that was the first wave and the devasting.

Now, let’s go through the project as we navigate over these provinces, we will show a click on the status option that will lead us to a particular situation. It will then calculate the total number of existing cases. Also, it will show the existing active cases, the number of cases returned and the death toll. In these regions the distinction of alpha and delta is also shown. This will also be done using the use of HTML and CSS in our code. Similarly, we will do this in all other provinces and the Union Territory of India.

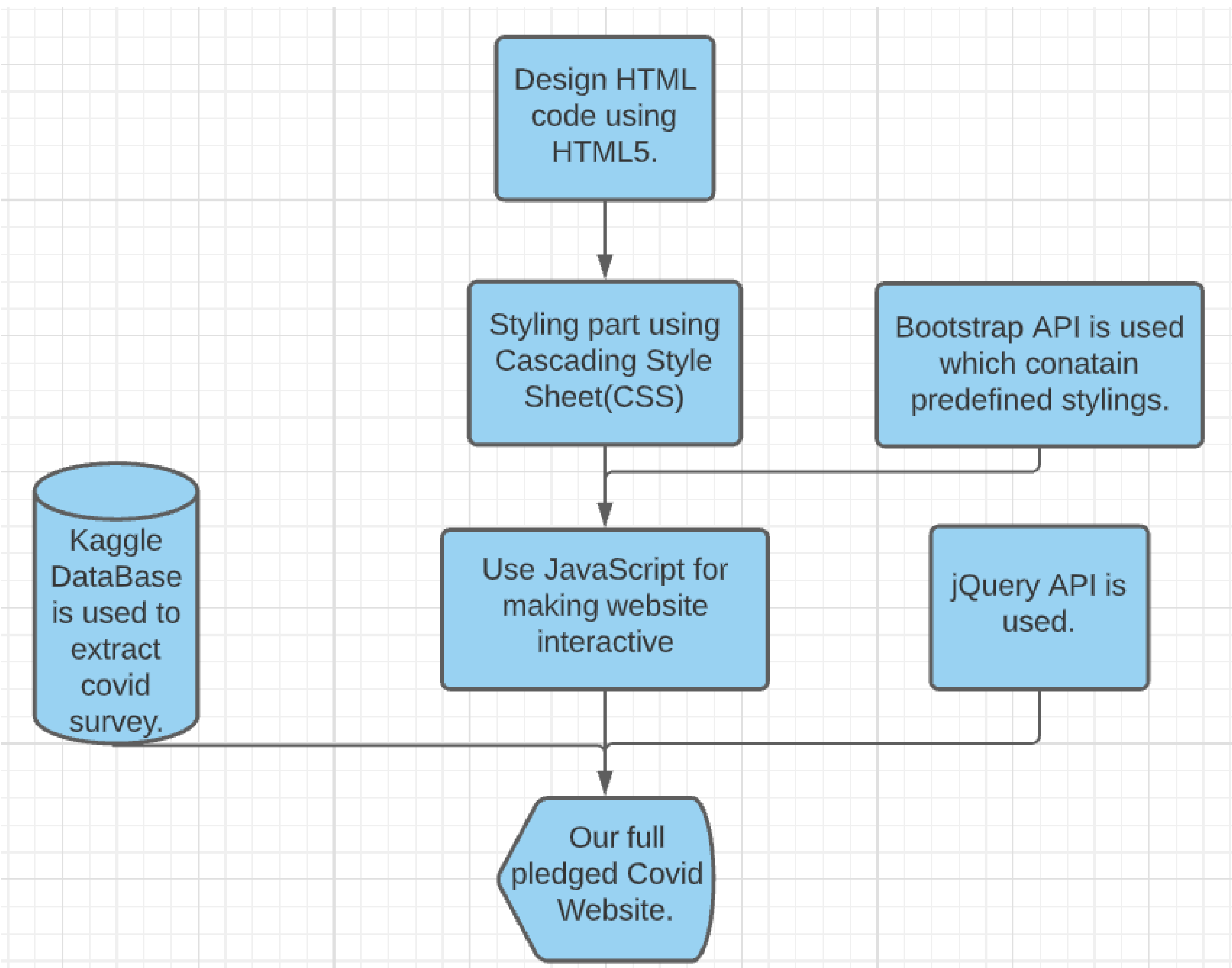
So, once we are done with our body and part of the style now it is time to connect it to our website which will show us the actual realities found. We will use the Kaggle website which contains cases reported in real time as the Government of India. The project will also help travelers to be reassured while traveling to a specific country due to serious offenses. It will also tell us which provinces to go to. Let’s look through the steps: -

Step 1: We will start using HTML create the basic structure of our webpage. Add elements like header, footer section and also content portion. We will also provide a link to Aarogya Setu webpage for registering for covid.

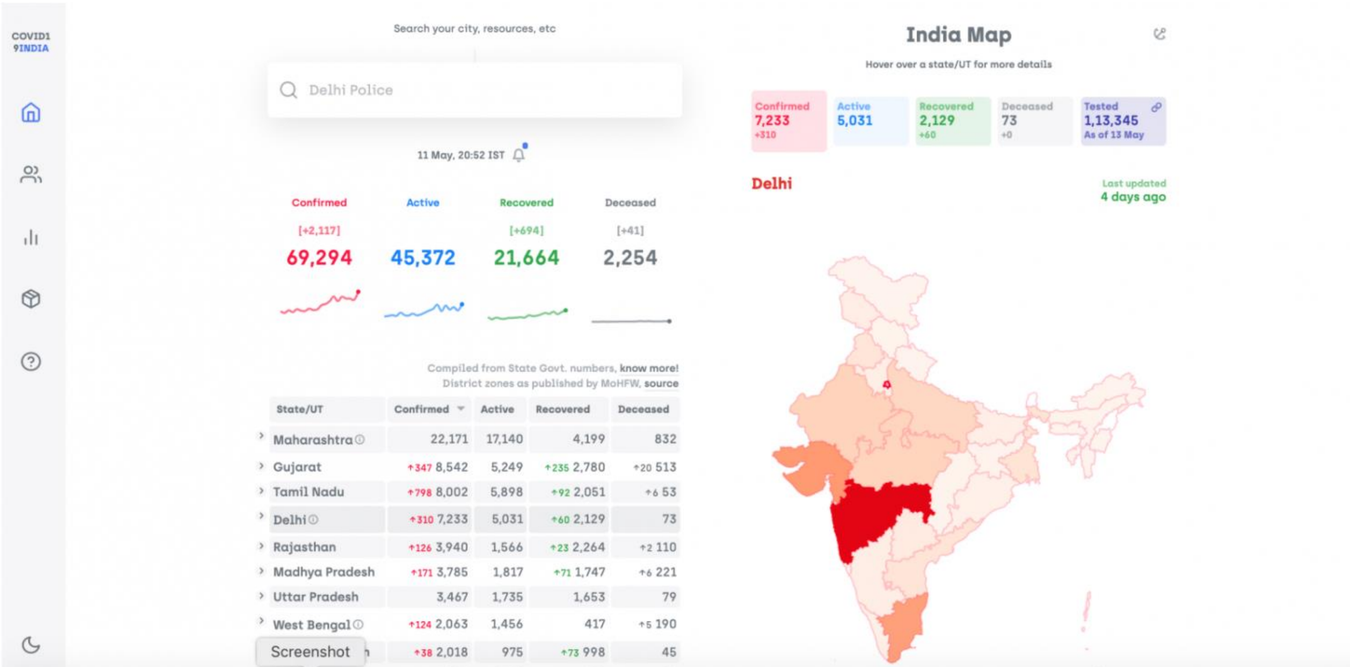
Step 2: We have now deal with styling using CSS. We will use it and make our website look interactive. We will also use a Bootstrap framework which will reduce our time and a better view of web page can be obtained from this.

Step3: We will use JavaScript to add user-based interactivity to our code. We will use jQuery framework which reduce the cost of coding the already defined part.

Step 4: We will link our website with the Kaggle database which will help us to get the actual covid report in India.



This is how our website will look like.

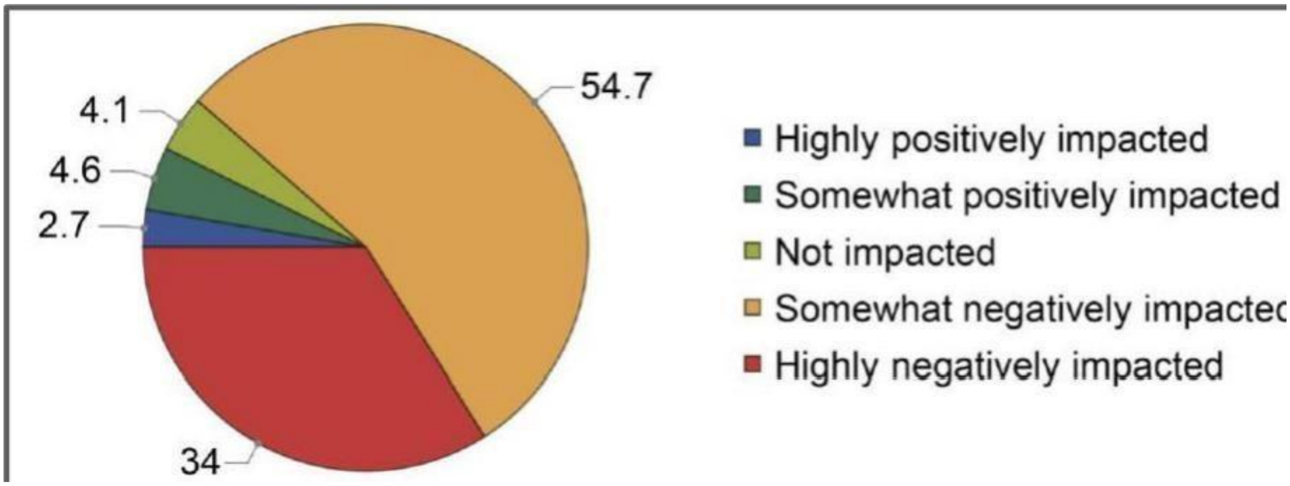


CHAPTER - 4

Results and Discussion

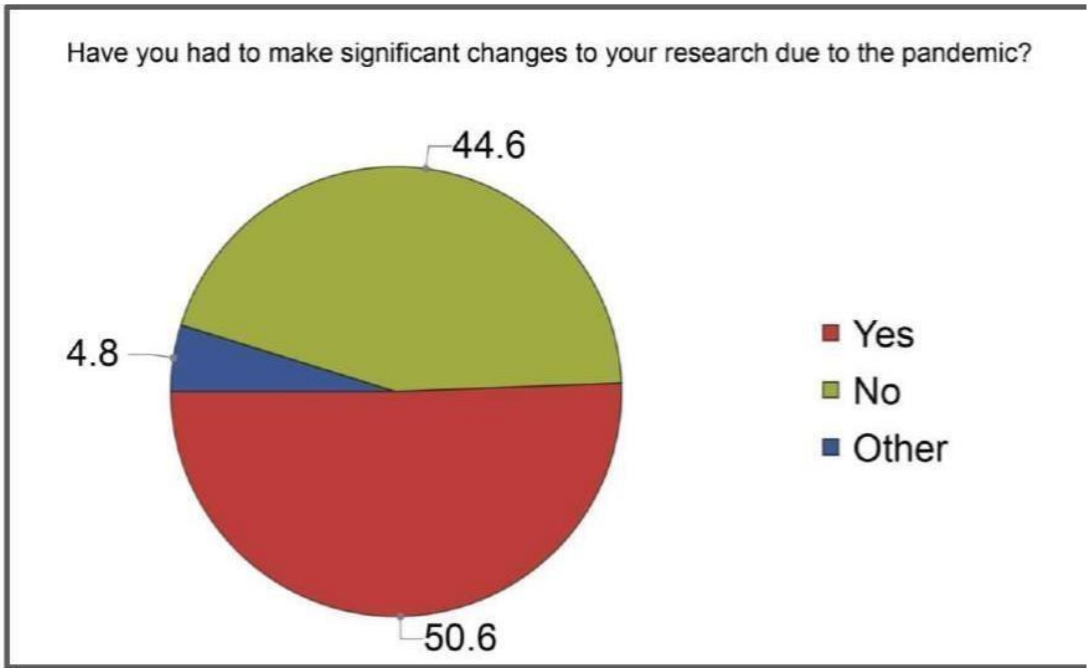
A small percentage of students experienced positive impacts of the pandemic. Of all respondents, 2.7% reported being highly positively-impacted, and 4.6% reported being somewhat positively impacted. Open-ended responses about positive impacts especially emphasized the benefits of working from home: schedule flexibility, lack of commute, ability to optimize work environment, and so on. Like many other fields of work, we should ask whether 7 with today's technology, we can continue allowing those who work best from home to reap those benefits, while maintaining strong collaborations. Finally, the proportion of MIT researchers who can benefit from remote work options may potentially be far larger than the 7.3% of respondents who reported a positive overall impact of COVID-19 on their research, since for some researchers the COVID-specific obstacles to research could have simply outweighed the benefits of work-from-home. For example, a social scientist might benefit from remote work but only when the libraries are open; a natural scientist may benefit from being able to do analytical tasks from home, but not until labs are fully open so they can obtain data to analyze. While the remainder of this report largely focuses on recommendations to mitigate negative impacts, we urge MIT decision-makers to consider how to preserve the positive aspects of work-from-home flexibility. I.2.c. Report outline Section II gives a high-level view of COVID-19's impact, including respondents' reports of how COVID-19 impacted their research overall, and whether they had to make significant changes to their research. It includes breakdowns of these pandemic impacts to research by School, citizenship status, and work style (on/off campus). Section III examines the potential sources of the pandemic's negative impacts via respondents' reported obstacles to research. Respondents had the opportunity to mark each of 18 potential obstacles as a "Major obstacle," "Minor obstacle," "Not an obstacle," or "Did not experience or N/A." The section "buckets" pandemic obstacles into those directly related to work; logistical/life obstacles; financial hurdles; and the burden of other duties such as caretaking. The scope and severity of each obstacle "bucket" is analyzed across schools, citizen status, and work types. Taken together, these sections sketch out impacts on MIT graduate researchers. Given the challenges of pandemic-era research, Section IV concludes with tailored GSC and MIT COVID Relief recommendations for campus efforts to alleviate these challenges. Town halls or other community-wide discussions should collectively acknowledge the scale of research impacts. Specific guidance should be developed for Schools and DLCs (departments, labs, and centers) to navigate these impacts. A COVID-19 Recovery Fund should be established, so that individual students or departments can access necessary resources to support delayed or restructured projects. As part of COVID-19 recovery, graduate students experiencing research challenges and delays should have access to funding extension support. Caregiver support should also be increased, to offset specific challenges faced by graduate student parents (and, we imagine, most parents on our campus). Finally, MIT should also draw on the experiences of its peer institutions - many of whom have instituted all or some of the recommendations below - to inform its responses to COVID-19 research impacts.

Research Impacts of the COVID–19 Pandemic This section overviews researchers' reports of how COVID–19 impacted their work overall. Results are subsequently broken down by indicators such as school, citizenship status, program stage or type. II.1. Overall impact of COVID–19 on respondents' research Combined, 88.7% of respondents reported being highly or somewhat negatively impacted by the COVID– 19 pandemic, with the remainder reporting no impacts or positive impacts (see Fig. 1 below).



A majority-negative impact on research seems in line with the reality of our time. As for how well the respondents represent the larger population of grad student researchers at MIT, we see the potential for opposing forms of sample bias. On the one hand, those whose research was negatively impacted may have been eager to complain about it on a survey; on the other hand, those who are deeply "in the trenches" struggling to get their research done may not feel like taking the time to complete a survey, or indeed even notice the emails and advertisements. Around half of respondents reported that they had to make significant changes to their research (Fig. 2 below). Some respondents wrote in answers to this question rather than selecting "Yes" or "No." .

Common themes in those write-in answers include respondents who felt that some but not all of their projects were impacted; that their theses were intact but additional humansubjects experiments would have strengthened their work; that changes to their research were mild; and/or that their research began during the pandemic and so remained in flux.



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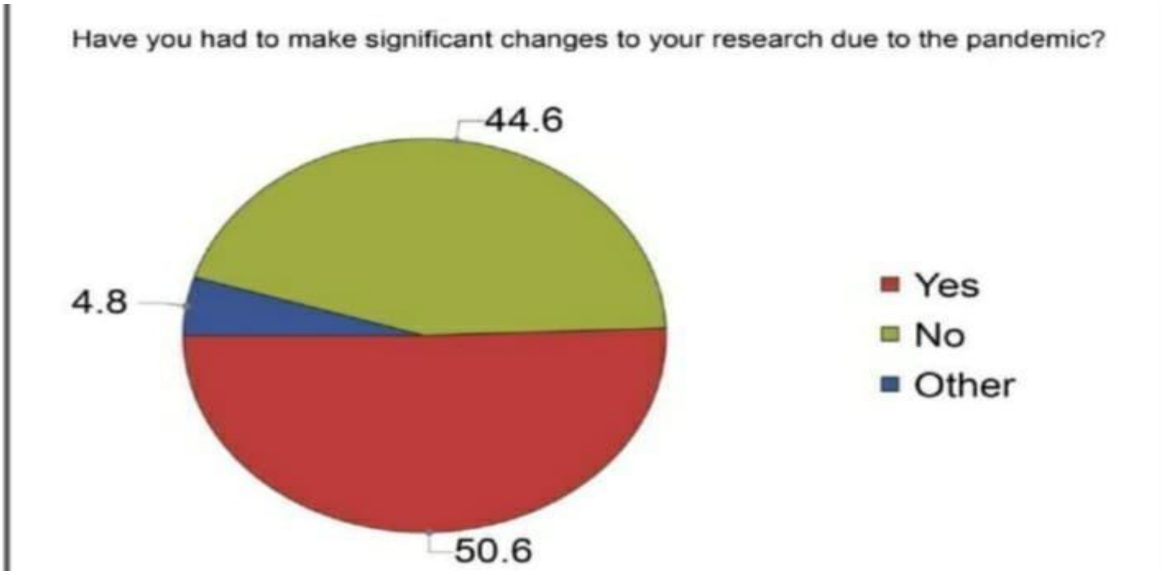
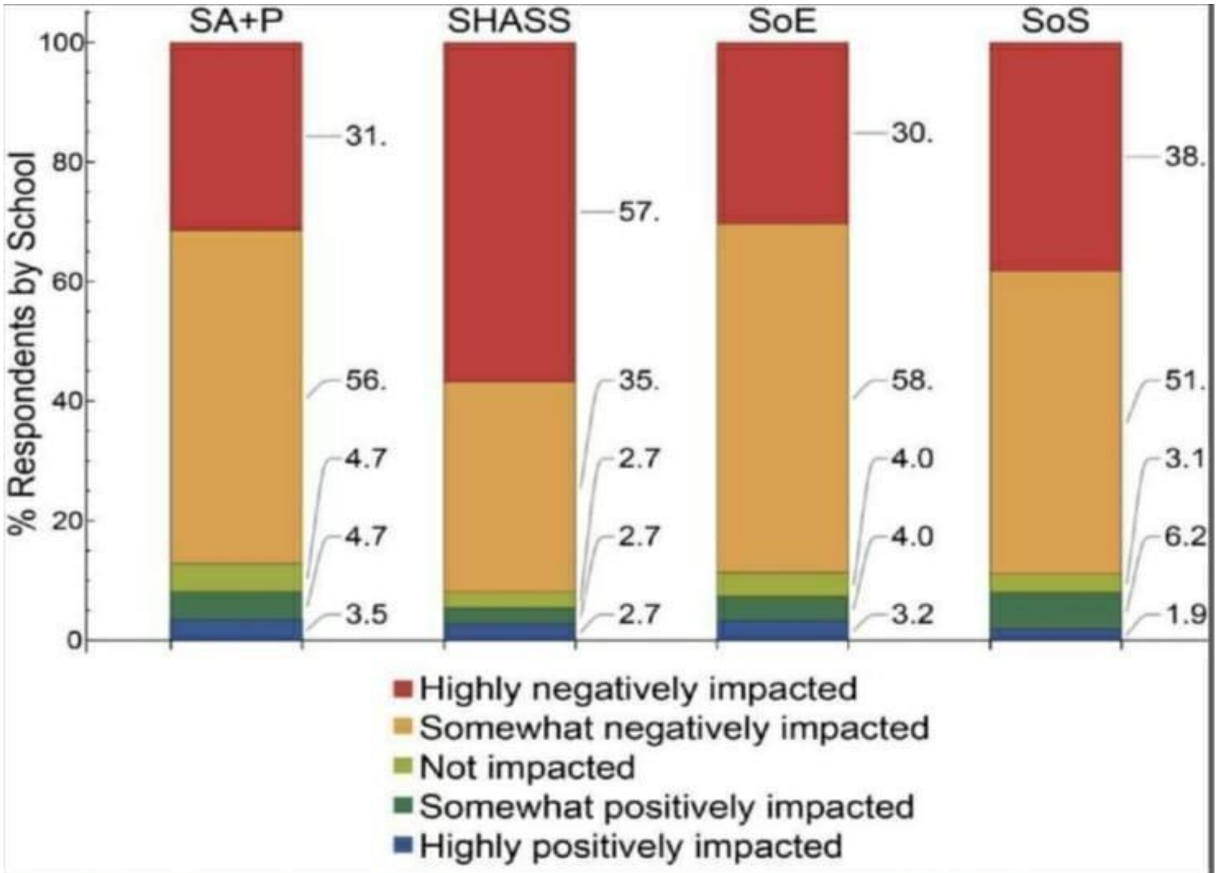
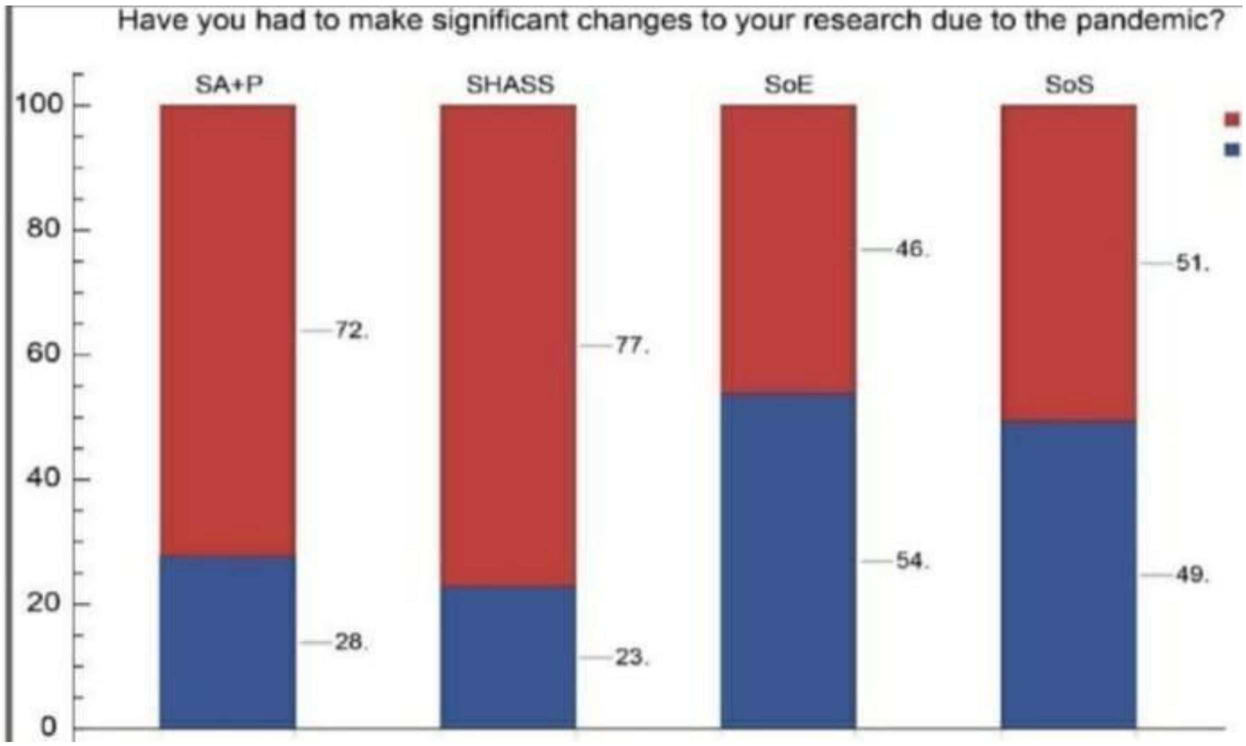


Breakdown by School II.2.a. Respondent affiliations Respondents were asked to give their department affiliation via a drop- down menu of options reflecting the Registrar's report. There was an option to write in a department/program not listed. (Students from IDM and SDM expressed frustration about perpetually being left off of lists of programs). We then used the same report to separate the respondents into Schools (Table 2). The majority of respondents in programs offered jointly between Schools were WHOI students. Table 2. Numbers of respondents by self-reported School affiliation School # Respondents SA+P (Architecture + Planning) 86 SHASS (Humanities, Arts and Social Sciences) 37 SoE (Engineering) 247 SoS (Science) 162 Sloan 12 Schwartzmann College 7 Joint programs 32 Undisclosed 6 10 Breakdowns of the responses by School will be given for SA+P, SHASS, SoE and SoS below. Though we saw some responses from Management and Operations Research PhD students, there were too few of those responses to make meaningful breakdowns for Sloan. II.2.b. Results The overall negative impact of COVID-19 on respondents' research held across schools (SA+P, SHASS, SoE, SoS); see Fig. 3 below. However, the reported scope and severity of COVID-19's impacts on research vary across campus. Among represented schools, SHASS respondents recorded the largest proportion of "highly negatively impacted" (57%). The School of Science respondents also reported they were "highly negatively impacted" more often than Engineering (38% vs 30%). Appendix V.1 will explore the disparate issues faced by Science students who worked in person on campus vs remotely.

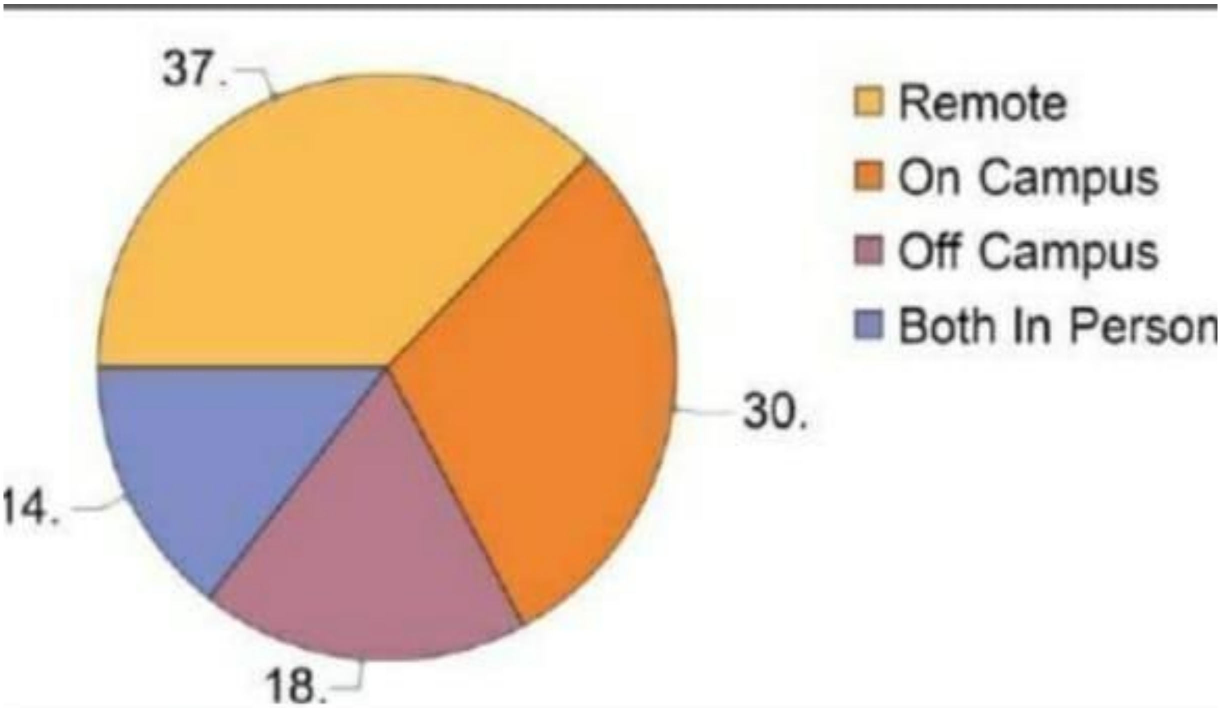


As a corollary of the overall impact of COVID-19 on their research, we asked respondents whether they had to make significant changes to their research. Respondents could answer "Yes" or "No," or write in another response. The School breakdown of respondents who gave a "Yes" or "No" is below (see Fig. 4). A substantially larger fraction of respondents from 11 SA+P and SHASS (72 and 77%) reported having to significantly change their research, compared to SoE and SoS (46 and 51%).

Interestingly, international students were also more likely to say their research was positively impacted by COVID-19. We can only make educated guesses about the factor(s) driving this result. One potential explanation is that some international students whose work didn't have inperson elements to begin with (computer scientists, theorists, etc.), and who worked remotely from places outside the US, may have had more control over their work environments. That hypothesis is so far supported by some anecdotes we have heard from our peers. Finally, we were somewhat surprised and heartened by the equal percentage of international and domestic respondents who reported having to make significant changes to their research. 13 That said, international students faced some specific (largely financial) obstacles more often than their domestic peers; see Section III.3 for more details.



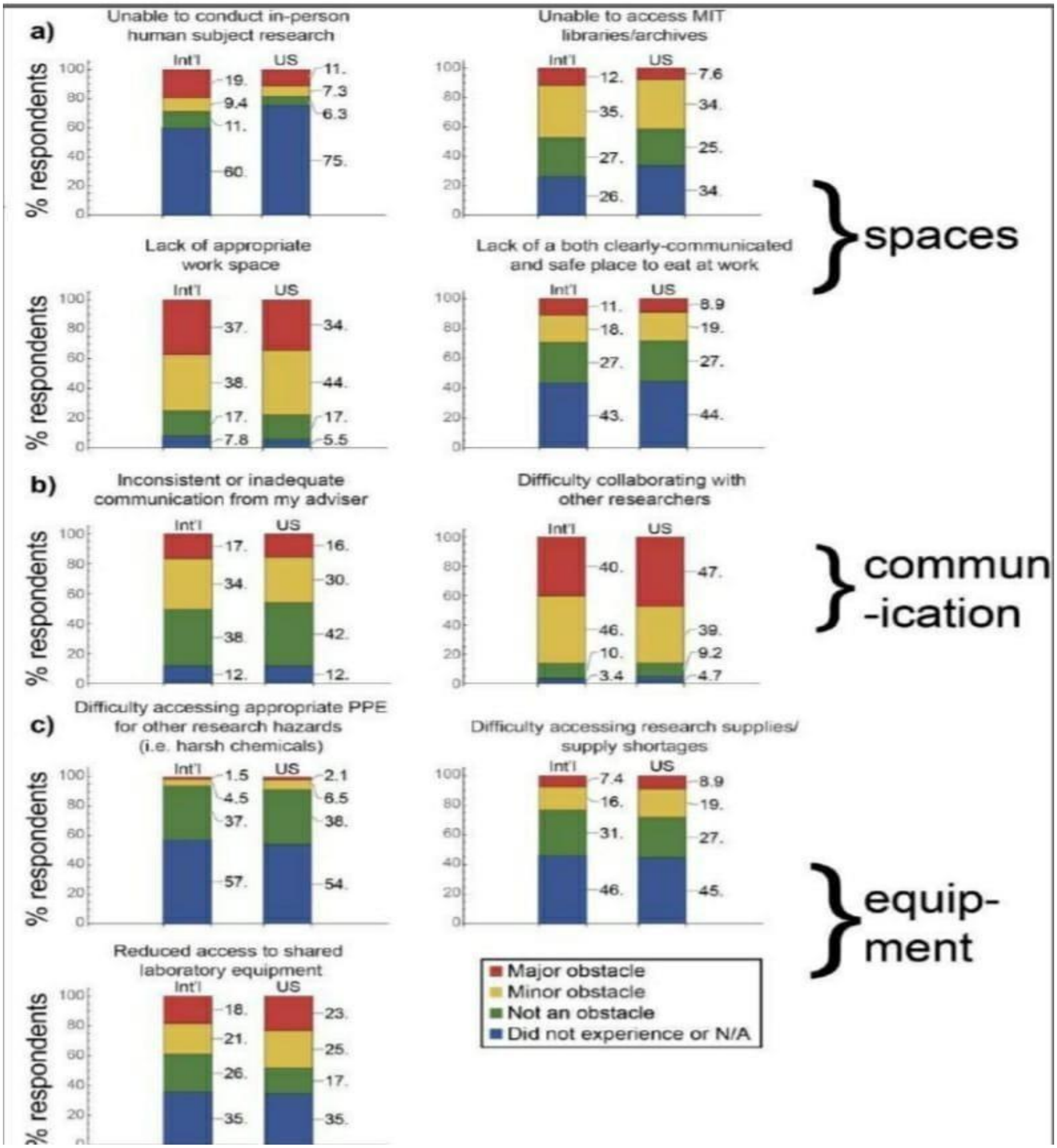
Breakdown by Work Site II.4.a. Respondent categories We asked respondents two simple Yes/No questions regarding where their research work took place: Does your research involve in-person work on MIT’s campus? Does your research involve in-person work off-campus? Almost all respondents (582/590) answered both questions. From there, four categories of respondents arose (no/no, yes/no, no/yes, and yes/yes), which we term “Remote” = fully remote, “On Campus” = working in person on campus, “Off Campus” = working in person off campus, and “Both In Person" = working in person both on and off campus (Fig. 8). Figure 8. Percentage of survey respondents at each work site. 14 II.4.b. Results The GSC leadership noticed a common assumption among some administration and faculty that researchers whose work was fully remote would not feel a negative impact from COVID-19. This assumption is not well supported by our data. For grad student researchers whose work involved coming to the MIT campus, 93% report a “highly negative” or “somewhat negative” impact (Fig. 9). For those whose work was fully remote, that figure was 84%. Thus, although the proportion of respondents who felt their work was negatively impacted was slightly lower for fully remote workers, the vast majority of researchers in both remote and the in-person work sites reported a negative impact of COVID-19 on their work.



More Details on Significant Changes to Research Students that made significant changes to their research do not break down evenly throughout the Institute. Uniformly high percentages of the graduate researchers in DUSP (69%), MAS (77%), and Architecture (67%), made significant changes to their research in light of COVID-19. These fields often require interview, observational, and ethnographic fieldwork. Similarly, designers often work in and with communities to complete research. To make matters more challenging, many scholars in these fields travel abroad for comparative or international work. A representative answer to our open-ended section illustrates these challenges for social scientists: “Lack of in-person research/travel is a HUGE barrier. Many social scientists have been encouraged to "pivot" to remote research, or change research plans entirely (i.e., switch fieldsites from a foreign country to the US). For many of us who have spent our entire grad careers (even undergrad research) preparing for our projects, these ‘pivots’ CANNOT be accomplished quickly, nor yield the same quality results. I live in fear of not collecting enough data to write a serviceable dissertation and get a job.”

Several individual departments stuck out as having a large portion of respondents reporting “Yes” to “Have you had to make significant changes to your research due to the pandemic?”: EAPS (27 of 38 respondents), and again the three SA+P departments - DUSP (20 of 29), Architecture (17 of 27) and MAS (23 of 30). Overall, 77% of the SHASS respondents said they had to make significant changes to their research; for several individual SHASS departments such as HASTS and Political Science, though the total number of responses was <20, we note that the vast majority of respondents report having to make such changes. These may represent academic fields where project continuity during the pandemic was particularly difficult. Graduate students' degree timelines represent another critical dimension of forced significant research changes. Students further along in their programs were more likely to have experienced research changes (Fig. 11). It's worth noting that the grad students who entered in 2017 - many of whom are now entering their fifth year - reported significant changes to their research at almost exactly the same rate as those who entered in 2015 or earlier (for many social-science programs, students actively conduct fieldwork during year 4). Departments with fixed-term funding have, at the time of writing, made substantial progress in getting research funding extensions to the 2015-and-earlier group. But anecdotally, quite a few grad student researchers in the 2017 cohort report that they're going into their fifth year already stressed about whether they'll be able to complete their dissertation research before funding runs out.

Breakdown by School In four Schools, enough graduate researchers responded to the survey for their responses to be broken down. We list them here with their abbreviations: ● School of Architecture and Planning (SA+P) ● School of Humanities, Arts and Social Sciences (SHASS) ● School of Engineering (SoE) ● School of Science (SoS) The research barriers mentioned above were strongly felt in all four Schools, as will be shown below. There were also research obstacles felt particularly strongly in one or two of the Schools, so we calculated the percentage of respondents in each School who marked each of our 18 research obstacles as a "Major obstacle," a "Minor obstacle," etc. and constructed stacked percentile bar charts of responses along four major themes: obstacles related to work, those related to logistical hurdles, financial obstacles, and other duties as obstacles. Some insights emerged from this view of the data, which will be discussed below. III.2.a. Obstacles directly related to work Below, we break down by School responses regarding those obstacles which can be felt while actively doing research tasks. These cover obstacles in three main categories: spaces, equipment and communication.



Space Most respondents suffered from lack of appropriate work space, regardless of School: Table 4: Work Space as an Obstacle Major obstacle % Minor obstacle % Not an obstacle % Did not experience or N/A % SA+P 32 41 22 4.7 SHASS 41 38 22 0 SoE 34 42 17 6.5 SoS 40 39 14 7.5 See also Fig. 14a. Experimentalists from the lab sciences commented on how their work suffered with a shift schedule, for example: Even as research activities ramped back up, occupancy restrictions meant my lab had to work in shifts (as many labs did). Bizarre hours, reduced contact with labmates definitely impacted research. Meanwhile those researchers who worked remotely noted that they couldn't necessarily afford to suddenly build a home office and pay higher utilities. This anonymous comment matched the experience of many researchers we heard from: I felt that MIT forgot about students who work from home. I spent 6 months without a proper place to work (I was going crazy living and working in a single room). I ended up making a better work situation for myself by moving into a new apartment; however this cost me a lot of money […] Students don't usually live in big houses with lots of space to live and work and professors, who often do, haven't shown much empathy with our situation. Even a small gesture like offering everyone who works from home an office chair, an extra monitor, etc, without having to explicitly ask around for it, would have gone a long way to make me feel taken care of/not forgotten. The majority of SA+P and SHASS respondents reported inability to conduct in-person human subject research (59% and 60% respectively) and inability to access MIT libraries and archives (72% and 73%) as obstacles (Fig. 14a). This may have influenced the high rates of research changes in those programs, as discussed more fully in Section II.2.b. III.2.a.2. Communication In terms of communication obstacles to research, responses largely held across the four Schools. Difficulty collaborating with other researchers was considered a "Major" or "Minor" obstacle by the majority of respondents from every school: 76% of respondents from SA+P; 76% of respondents from SHASS; 91% of respondents from SoE; and 85% of respondents from SoS (Fig. 14b). One of the stories behind these numbers is demonstrated by the comment below: The biggest negative impact COVID-19 has had on my research is the complete disintegration of any sense of community, both in my lab and in the department. I am 22 conducting research in an isolated bubble and am thus probably wasting time on stuff no one cares about. About half of respondents from each school also reported inconsistent or inadequate communication from their advisor as a major or a minor obstacle to their research during the pandemic: 41.5% of respondents from SA+P; 49% of respondents rom SHASS; 48% of respondents from SoE; 46% of respondents from SoS. Section IV.2 contains recommendations for possible ways to alleviate these difficulties. III.2.a.3. Equipment Reduced access to shared laboratory equipment was considered a major or a minor obstacle by about a half of respondents from SoE (51%) and SoS (54%) and a third of respondents from SA+P (35%). See Fig. 14c. Together, those represent a large fraction of survey respondents. As a constructive idea, MIT could invest in equipment to be shared between smaller groups, which could reduce the impact of equipment failures on experiment output in the present (see Section IV.2.g). This will also relieve the workload of graduate and postdoctoral researchers, who often have to go to great lengths to make outdated, inappropriate or inaccessible equipment work. With more robust research infrastructure, we have the capacity to reduce the research impact of the next crisis. III.2.b. Logistical/life obstacles COVID-19's impacts on graduate research extend beyond the research work itself. Many respondents reported logistical and quality-of-life obstacles to their research. As is illustrated by Fig. 15 below, more than half of respondents from each school report mental/physical health issues as a major or a minor obstacle: 85% respondents from SA+P (49% -- major obstacle, 36% -- minor obstacle), 89% respondents from SHASS (62% -- major obstacle, 27% -- minor obstacle), 82% respondents from SoE

(45% -- major obstacle, 37% -- minor obstacle) and 85% respondents from SoS (53% -- major obstacle, 32% -- minor obstacle). These data show that mental/physical health issues due to the COVID-19 pandemic create a serious obstacle for students from all four Schools and, unsurprisingly, have a negative effect on the research progress across disciplines in similar measure. More than half of the respondents from SA+P and SHASS reported inability to travel or difficulty travelling as a minor or major obstacle to their research. As is illustrated by Fig. 15, inability or difficulty travelling was considered an obstacle to their research by 81% of respondents from SHASS and 76% of respondents from SA+P. A significant proportion of respondents from SoE and SoS also cited inability or difficulty traveling as a major or a minor obstacle: 48% of respondents from SoE and 44% of respondents from SoS. This commenter demonstrates why not being able to travel negatively impacts degree timelines: Lack of in-person research/travel is a HUGE barrier. Many social scientists have been encouraged to "pivot" to remote research, or change research plans entirely (i.e., switch field sites from a foreign country to the US). For many of us who have spent our entire grad careers (even undergrad research) preparing for our projects, these "pivots" CANNOT be 23 accomplished quickly, nor yield the same quality results. I live in fear of not collecting enough data to write a serviceable dissertation and get a job. Additionally, this commenter spoke to the indirect but powerful impact of not being able to visit family: As an international student, I found it extremely difficult during the pandemic to travel home and see my family, due to travel bans and visa closures. (If I leave the U.S., I may not be able to re-enter the U.S. in the near future.) Some of my family members need help, but I cannot visit them. This dilemma is very stressful and hindered my productivity. Figure 15. Logistical/life obstacles, breakdown by school SoS respondents were somewhat more likely to report “Mental/physical health issues” as an obstacle than SoE, possibly contributing to SoS’s slightly higher percentage of researchers reporting a negative impact of COVID-19 (Sec. II.2). This Engineering respondent demonstrated how the pandemic’s mental health effects manifested: 24 COVID has been severely affecting my mental health, it took me a year to finally get back to a more productive state. I had this fear that I'd be a failure if I didn't succeed, but no one in my lab acknowledged the state of the pandemic and how that negatively impacts research productivity. No one at MIT says it is ok to not be productive when your life has been upended, especially for international students. III.2.c. Financial obstacles COVID-19 created serious financial obstacles for students from all the four Schools, with perhaps the highest burden felt in the social sciences. The most commonly reported obstacle is uncertainty about funding for future years of the PhD. In fact, 41% respondents from SA+P, 76% respondents from SHASS, 35% of respondents from SoE and 32% respondents from SoS consider this as a major or a minor obstacle, as is illustrated by Fig. 16 below. Another commonly reported financial obstacle can be described as funding challenges for research groups. It is considered to be a major or a minor obstacle by 42% respondents from SA+P, 33% respondents from SHASS, 27% respondents from SoE and 18% respondents from SoS.

Other duties as obstacles Respondents with families in particular reported that their non-research everyday duties were also negatively impacted by the pandemic, which in turn, had an effect on their research. See, for example, the following comment: We have been heavily impacted by the pandemic, our ability to do research got severely reduced due to the lack of childcare and even now that many options are back open, we see the impact of the pandemic in our kids which impacts our overall mental health and therefore research output. The mental toll of the pandemic is really hard to manage and as the pandemic keeps going, our mental health keeps deteriorating given the extreme challenge of working and caring for young kids in the pandemic. The fraction of respondent researchers marking this obstacle was small (Fig. 17), likely due to the relatively small fraction of MIT grad students who have children (~7% based on the 2019 grad Enrolled Student Survey). Nonetheless, policy-making in response to the pandemic must take graduate parents into account; see Section IV.2 for related recommendations. Finally, 15-25% of respondents in each School marked “Increased undergrad teaching or mentoring duties” as an obstacle to research, as shown in Fig. 17. SHASS respondents were particularly likely to mark both these outside duties as a “Major obstacle” to research. Figure 17. Obstacles related to alternate duties, broken down by School 26 III.3. International and US student researchers As mentioned previously, 34.5% of respondents marked themselves as “International” and 65.5% as “US.” This is not too distant from the approximately 41% international enrollment in MIT’s graduate programs overall. Figure 18: Obstacles directly related to work, International vs US 27 While international and US student researchers who responded to the survey experienced similar rates of overall positive and negative impacts on their research, and equivalent rates of having to make significant changes to their research (see Section II.3), there were some differences between international and US respondents when it came to specific obstacles to their research. Below, we break down international vs US respondents’ responses to the research obstacle questions and point out the differences. Aside from the obvious increase in travel difficulties, international researchers experienced financial obstacles at higher rates than their US peers.

III.3.a. Obstacles directly related to work International respondents were more likely to report a couple of directly work-related obstacles to their research: ● Unable to conduct in-person human subject research (28.4% vs 18.3%) ● Unable to access MIT libraries/archives (47% vs 41.6%) On the other hand, US researchers were marginally more likely to report obstacles regarding access to equipment and supplies (Fig. 18 above). These differences may reflect the disparate percentages of international workers in different programs and Schools. The MIT Institutional Research office’s Graduate Education Statistics pages show that 35% of School of Science (SoS) grad students are international, compared to 46% in the School of Humanities, Arts and Social Sciences (SHASS), for example. Correspondingly, SHASS students were more likely to mark the human subjects research and library access obstacles, while SoS students were more likely to mark the lab equipment and supplies obstacles (See Section III.2.a). III.3.b. Logistical/life obstacles International respondents were more likely than US respondents to report “Unable to travel or difficulty traveling” as a “Major obstacle” to their research (32% vs 18%); see Fig. 19 below. In the open responses, international respondents commented on the negative impacts of getting stuck outside the US, being unable to visit family, and the process of getting remote appointments approved. Some researchers working remotely reported feeling cut off from their support systems in the US, while others wanted to stay near their support systems in their home countries; both effects could contribute to travel difficulties as a research obstacle. Finally, researchers in some parts of the world also struggled to get access to healthcare and vaccines, adding substantially to their pandemic health burden and stress levels. An observation that seems connected was that international respondents were more likely to report “Loss of housing” as either a “Major obstacle” or “Minor obstacle” to their research (15% vs 9.5%, Fig. 19). Anecdotally, the GSC heard a number of complaints from student workers who had been working remotely from Europe about enormous lease termination fees when they were suddenly asked to return to the US on short notice for Spring 2021. Finally, for both US and international researchers, mental/physical health issues were a commonly and evenly reported obstacle to research (Fig. 19). Accordingly, we should ensure resources aimed at recovery of mental and physical health should be designed to be easily accessible to researchers of all nationalities, and those few who are still working remotely. 28 Figure 19: Logistical/life obstacles, International vs US. III.3.c. Financial obstacles The survey asked about three potential research obstacles related to finance and funding. For each of them, international respondents were more likely to mark it as an obstacle to their research (Fig. 20). International respondents were more than twice as likely to report “Funding challenges for your research group as a whole” as a “Major Figure 20: Financial obstacles, International vs US 29 obstacle” to their research compared to their US peers (17% vs 6.8%). Possible reasons for this include restricted funding sources such as grants from government agencies that can only be used for US students, or international students could simply be concentrated in programs that happened to be hit with more funding cuts. International students were also more likely to report uncertainty about future funding as a major or minor obstacle (49% for international researchers vs 32% for US citizens). One possible explanation for this is that in programs with limited funding, students at the end of their funding packages typically rely on external fellowships to complete their degrees; many such fellowships include citizenship requirements or are otherwise unavailable to international researchers. International students are also limited in their employment options outside the Institute. See Section IV.2 for relevant recommendations on financial hurdles. III.3.d. Other duties as obstacles International students also faced obstacles from other duties or obligations (see Fig. 21). For example, international respondents were more likely to mark “Increased need for child/dependent care” as a “Major obstacle” to their research (8.0% vs 3.9%). It’s possible that more international grad students happen to have children, or that they have a harder time finding child care options. We can’t distinguish those two possibilities with the data from this survey. However, this international grad student makes a case for why we need to better support for parents regardless: International parents may be especially vulnerable as they already face higher expenses from traveling, visa processing, etc., and can't always benefit from financial aid for parents offered by the state or federal government. Also, those spouses of grad students who enter the US on F2 visas are not authorized to work, forcing the family to subsist on one grad student's income - which was difficult if not impossible even before the pandemic. These parents are a valuable part of the MIT community, and should be given the funding they need to support their families so they can continue making their unique contributions to research at MIT.

Future Research Directions

Future Research Directions While this survey helped us understand the broad picture of impacts to research caused the COVID-19 pandemic and MIT's response to it, there were dimensions to research impacts which we did not record, and thus may be underrepresented in this survey. We made the choice to exclude finer-grained demographic info to reduce the length of the survey, maintain anonymity, and increase response rate. However, this left us without a breakdown of the impact of COVID-19 on various marginalized groups, including women and non-binary people, people of color, and disabled/neurodivergent people. Figure 25: Other duties as obstacles, breakdown by work site 34 The survey included a free-form text input for respondents to include information that was not otherwise asked about in the survey. Many responses indicated that there was an increase in difficulty of classes which was a significant source of impact on research, as demonstrated below. Future assessments might ask more thoroughly about pandemic workloads. Research has been significantly impacted in an indirect route due to classes being more challenging/harder to do well in, harder to collaborate with students, and feeling like I have not really been part of a community since starting graduate school. International students reported financial obstacles to their research at higher rates than domestic students (see Sec. III.3.c). Since universities strive to transcend the barriers of nationality and bring people together to solve humanity's common problems, it may be worth assessing in more detail where these disparate impacts came from, and what more MIT can do to shield international graduate researchers from funding discrimination or other financial disparities. Finally, our survey only focused on graduate students at the Institute. To get a clearer picture of the broader impact of the pandemic on research, additional surveys which include research staff such as postdoctoral associates may be necessary. IV.2. Recommendations IV.2.a. Recommendation: Collectively acknowledge + navigate research impacts In their qualitative responses, many students pinpointed a sense of loneliness in weathering the pandemic. As one respondent put it (emphasis added): COVID has been severely affecting my mental health, it took me a year to finally get back to a more productive state. I had this fear that I'd be a failure if I didn't succeed, but no one in my lab acknowledged the state of the pandemic and how that negatively impacts research productivity. No one at MIT says it is OK to not be productive when your life has been upended, especially for international students. As MIT collectively recovers from the COVID-19 pandemic, we must openly acknowledge the range of research impacts and problem-solve together to get campus back to 100%. We recommend a series of town halls or workshops for MIT students to give voice to these research impacts and to further understand the needs of the student body. Various student initiatives already work to normalize the failures and difficulties of research, for example the FAIL! Series; these demonstrate the value of collectively acknowledging difficult experiences and low points. The pandemic has been a time of enormous pain, stress, grief, and disruption for communities across campus. As vaccination rates increase and we anticipate a return to full in-person work in the fall, we cannot ignore or forget the reverberating impacts of a year of research under pandemic conditions. MIT must convene forums for graduate researchers and the broader MIT community to express and navigate these difficulties together. [35]

IV.2.b Recommendation: Fundraising for Long-Term COVID-19 Recovery

Recovering from the disruption of the COVID-19 pandemic will require more than just verbal commitments to support students and departments; it will require clear financial commitments on the part of the administration. MIT has the resources to properly fund COVID recovery. MIT saw an 8.3% return on investments for its endowment in the fiscal year ending June 2020, and since that time, the stock market has only continued to improve, with the S&P 500 seeing returns of almost 40% for the period from June 2020 to July 2021. MIT is on much safer footing than it was at the end of the 2008 recession, when its endowment dropped by more than a quarter. In addition to funding COVID recovery through its endowment, we recommend that MIT tap on its broad donor network to raise funds specifically to be used for COVID recovery programs. MIT COVID Relief has now shown with two surveys that PhD students in fixed-term-funding programs have not gotten the message that funding is available if they expend their funding packages before finishing their dissertations. This is still the case months after that funding was made available. The previous practice of relying upon department heads and deans to relay and act upon this information has not resulted in broad awareness that research extension funding exists. Many report inefficiently executing two research plans simultaneously in case their planned dissertation research can't be finished before they're forced to graduate or lose funding. Given this, MIT should raise and distribute COVID recovery funds to departments and students through universal, broadly-advertised, and centrally-administered grants. Experience with MIT's current approach to pandemic relief funding (e.g. COVID-related extensions for PhD funding) has shown that it idolizes local administration and budgetary cleverness over actually providing relief to those who need it. As MIT COVID Relief has made clear in the past, universal and centrally-funded grant programs are the only way to ensure that departments and students will be able to equitably and speedily receive the support that they need. While we expect that the pandemic will continue to have long-term effects that will need to be addressed, we have several further recommendations for specific grant programs that MIT should institute. IV.2.c. Recommendation: Universal funding extensions for graduate students While many graduate students at MIT have been able to rely on consistent funding until graduation, this is not the case for all students. Students in departments with fixed-term funding, such as those in SHASS and SA&P, as well as Mathematics (SoS), have "funding cliffs" - that is, their funding runs out after a predetermined length of time. These funding cliffs have been an ongoing issue for students in these departments even before the pandemic, as while most of these departments only guarantee five years of funding, doctoral time-to-degree completion averages closer to 6 or 7 years (in SHASS and SA+P), leaving students to search for funding at a pivotal time in their graduate career. The COVID pandemic has only further exacerbated this problem. Students are now expected to complete their degree within the same timeframe even as they struggle with all the other issues 36 that the pandemic has created. Meanwhile, students in SoS and SoE programs also report delays to their degree progress or forced changes to their research. In August of 2020, Provost Schmidt verbally committed to providing funding extensions to graduate students whose degree progress was affected by the pandemic. However, there was little commitment on the part of the administration to actually ensure that students received these extensions. In a preliminary survey of students in fixed-term funding programs conducted in February/March 2021, we found that the majority of respondents were unaware of the availability of funding extensions, and that even faculty and department administrators appeared to be unaware or misinformed of this promise. As a result of a push by MIT COVID Relief, the administration published clearer language around these extensions. However, to this day, many students in departments with fixed-term funding still lack confirmation around funding extensions, stymied by administrative backlog and negotiations. Furthermore, MIT has only committed to extensions for late-stage graduate students. However, both early and late stage students suffered from delays to their research: It's hard to know how much those of us in the early stages of the program will be able to catch up in future years, and thus whether we'll need funding extensions, but I don't feel like I've accomplished anything in the past year and a half. Given the number of respondents (both early and late-stage) who pointed to uncertainty around funding as a significant obstacle to their research, we recommend that MIT take immediate action to resolve this standstill by guaranteeing universal, centrally-funded extensions to graduate students in all years and fields. IV.2.d. Recommendation: Increased support for caregivers/parents Grad students with families have been heavily impacted by the pandemic, our ability to do research got severely reduced due to the lack of childcare and even now that many options are back open, we see the impact of the pandemic in our kids which impact our overall mental health and therefore research output. The mental toll of the pandemic is really hard to manage and as the pandemic keeps going, our mental health keeps deteriorating given the extreme challenge of working and caring for young kids in the pandemic. Graduate student parents and caregivers have long been underrepresented at MIT, and their issues have long been ignored by the central administration. Even before the pandemic, graduate families were forced to survive on near-poverty wages, especially international graduate families, who experience additional restrictions on their ability to work. Given the overall contraction of the US economy, especially in terms of jobs, during the pandemic, the number of graduate families who were forced to survive on near-poverty wages was even greater. We applaud MIT's recent moves towards dealing with these issues, including the recently instituted MIT Grants for Graduate Students with Children, but this support needs to be much more robust. 37 Being a parent is financially draining due to the limited support by MIT. Especially as internationals with less family support and partners having difficulty to find work, I really don't know how to pay for everything. Radically increasing (5-10k / 1-2k monthly to match what MIT charges for childcare) the amount awarded by the Grant for Graduate Students with Children would be extremely helpful here. The current grant only provides $5-7k per academic year for graduate students with families, which is a drop in the bucket compared to the cost of childcare, which averages $1750 a month in Massachusetts for a single infant. Graduate students are additionally unable to take advantage of scholarships for daycare providers at MIT, which are only available to MIT faculty. Providing graduate students access to these scholarships would go a long way to alleviating the costs of childcare for graduate student parents and caregivers. The COVID-19 pandemic also coincided with several drastic changes at the Institute which have far-reaching effects on the graduate population, especially parents and caregivers. In August 2020, MIT closed Eastgate, one of two family residences available at MIT at the time, and replaced it with new housing options which were significantly more expensive, sometimes above market-rate. This unnecessarily cruel move belies a lack of understanding of the limited income available to graduate parents and caregivers, and moves MIT away from its spirit as a researchoriented institution and towards a profit-driven one. MIT must stop their steady march towards profit-driven housing and offer affordable housing choices for all graduate students, especially those with families. IV.2.e. Recommendation: Fair Institute reopening As it becomes safer and more feasible for campus to reopen and more research to proceed, MIT must ensure that both short-term (i.e. as a result of the pandemic) and long-term inequities in access to Institute resources across different research groups are not reproduced or exacerbated by the reopening. We recommend that MIT work with students and faculty to create research group-level plans for reopening campus. Furthermore, we recommend that MIT commit to additional funding (i.e. separate from departmental/research group-level budgets) to address inequities which are identified as a result of this process. We further recommend developing guidance for DLCs and advisors to adjust workload or progress expectations, and, crucially, ensure that these adjusted expectations are taken into account during student progress meetings. IV.2.f. Recommendation: Draw from examples/models of institutional support for graduate students MIT's peer-level ranked institutions (Harvard, Stanford, Yale, Duke, UC Berkeley) have supported their graduate students on a university-wide level in multiple forms, including onesemester to one-year time-to-degree extensions, substantial tuition reduction (or remission once students reach ABD status), and dental insurance. MIT has not offered these lines of support to graduate students. We urge MIT to act in alignment with peer institutions on COVID-19 relief and recovery policies. This will ensure equity across graduate populations and maintain the Institute's peer competitiveness as we navigate unprecedented crisis. 38 IV.2.g. Recommendation: Create infrastructure to help manage the next crisis Realistically, there is a decent chance we will experience another global crisis in the next century. That could be another pandemic, fueled by habitat destruction, or another world war. We recommend that MIT establish concrete plans for the future to alleviate the impact of future crises -- for instance, establishing fair standards for use of space, resources and equipment. We have had some ideas of enhancements to our research infrastructure that could both help research in the present and soften the impact of future crises. Those ideas include: Build a more efficient and accessible system for MIT's on-campus researchers to reserve conference rooms and classrooms. As a design principle, ensure that researchers can be easily assigned to access clusters, i.e. based on their departmental affiliation and lab location, and that the list of rooms each cluster of researchers can book can be easily updated. (This project may lend itself nicely to a smartphone app). Create a system to facilitate sharing of research supplies across campus, not just within an individual department. There is no reason a Biological Engineering lab that has extra pipette tips can't give some to a Chemistry lab that's struggling, and vice versa. This could help researchers deal with day-to-day issues in normal times as well. Use a common system across campus to manage access and scheduling of shared equipment, while allowing DLCs to tune parameters such as hours, time slots and access groups. Make a special investment in purchasing pieces of lab equipment in strategic locations to reduce the amount of equipment sharing between building clusters. In practice, this should help interdisciplinary labs and labs that are branching out into new disciplines, as quite often arranging access to needed equipment can be a rate limiting step. COVID-19 has upended lives across the Institute. It has disrupted work and degree progress, as well as fueled significant degrees of stress, grief, and fear. In light of these challenges, MIT must implement COVID recovery policies and programs that acknowledge the shared impact of the pandemic. At the same time, COVID recovery must respond to specific instances of disparate impacts, for example to graduate researchers with families or on fixed-term funding. As the Institute cycles into the third academic year under COVID's shadow, we must also responsibly plan for an uncertain future. MIT has weathered acute emergency with tremendous energy and innovation - it can and should approach the chronic impacts and halting recovery with the same.

Chapter 5
Conclusion and Future Scope

Scope

The scope of this document is to provide clear guidelines on prevention and treatment of co-infections of COVID with diseases like Dengue, Malaria, Seasonal Influenza , Leptospirosis, Chikungunya etc.

DATA PRE-PROCESSING

Data pre-processing is a data mining technique that involves transforming raw data into an understandable format. Real-world data is often incomplete, inconsistent, and/or lacking in certain behaviors or trends, and is likely to contain many errors. Data preprocessing is a proven method of resolving such issues. Data preprocessing prepares raw data for further processing.

Steps Used :

1. Scrapped data was in raw form all information in a single file. So we needed to make separate files based on their purpose.
2. Death rate in each state is calculated by the formula (number of deaths/total confirmed cases)*100.
3. Recovery rate in each state is calculated by the formula (number of recoveries / total confirmed cases)*100.
4. Split the data according to the lockdown periods.
5. Null values in state wise GDP data filled with average.

TYPES OF VISUALIZATION USED

Pie chart:-To show active ,recovered, death percentage due to COVID and gender distribution.

Bar Plot:-To show state comparison on various factors, age-wise distribution etc.

Line Plot :- To show confirmed , recovered , deceased trend on daily basis.

3D plot:- To show state wise daily count of confirmed cases.

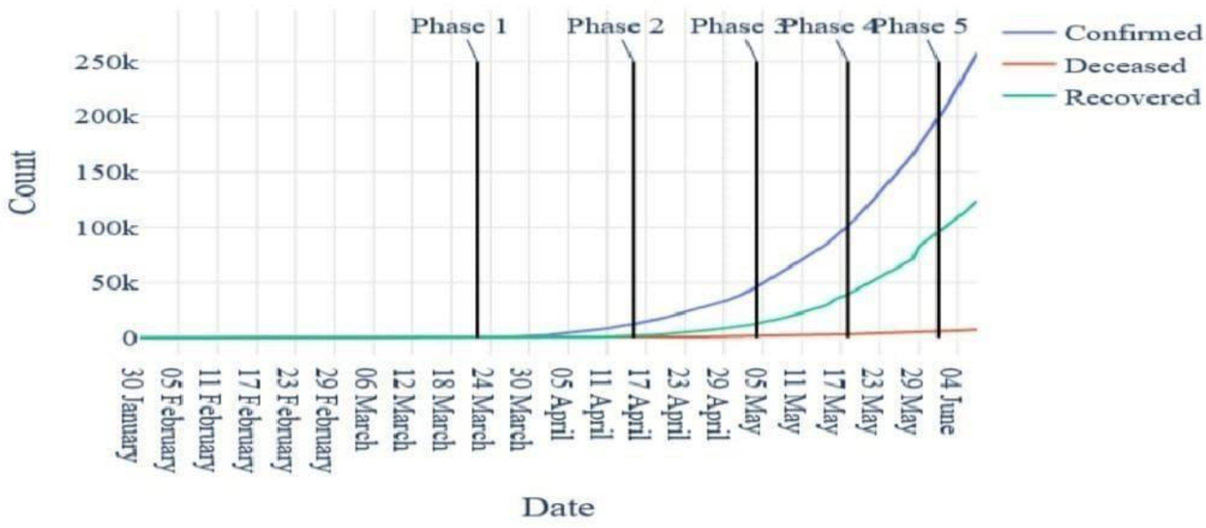
TECHNOLOGIES USED FOR VISUALIZATION

Python and Tableau are used to make all the visualizations which are displayed on the dashboard.

Plotly and matplotlib are the python libraries used for the visualization

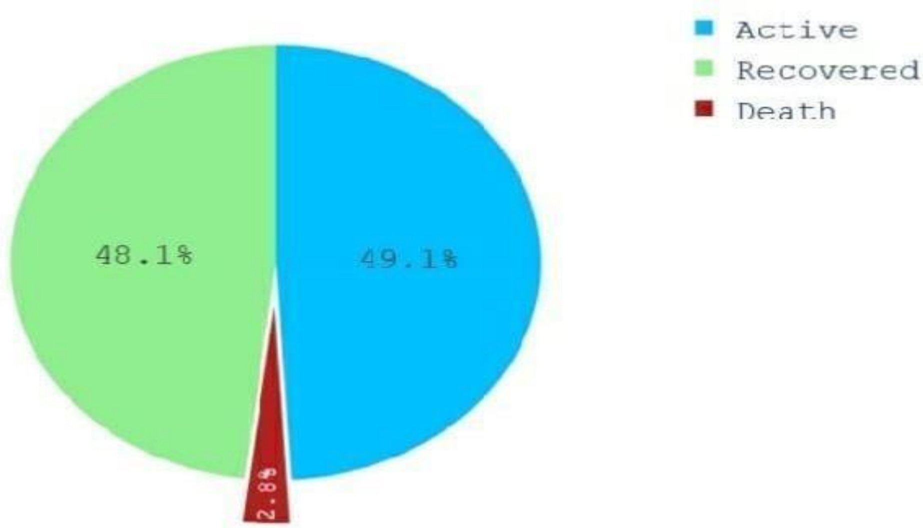
ANALYSIS (IMPLEMENTATION)

India recorded its first COVID-19 case on 30th January 2020 in kerala. The infected person was a student who had travelled to china for academic purpose. And since then cases in India is rising exponentially.



As shown above, India had recorded over 500 cases till 24th March. So government declared nation-wide lockdown from 25th march to 14th April also known as lockdown 1.0 and after this government has been extending nation-wide lockdown step by step.

Confirm Cases : 257487
Recovered : 123848
Active : 126433
Deceased : 7206



India is showing good recovery rate day by day with low rate of deaths but on the other hand it is also reaching new peak of confirmed cases everyday.

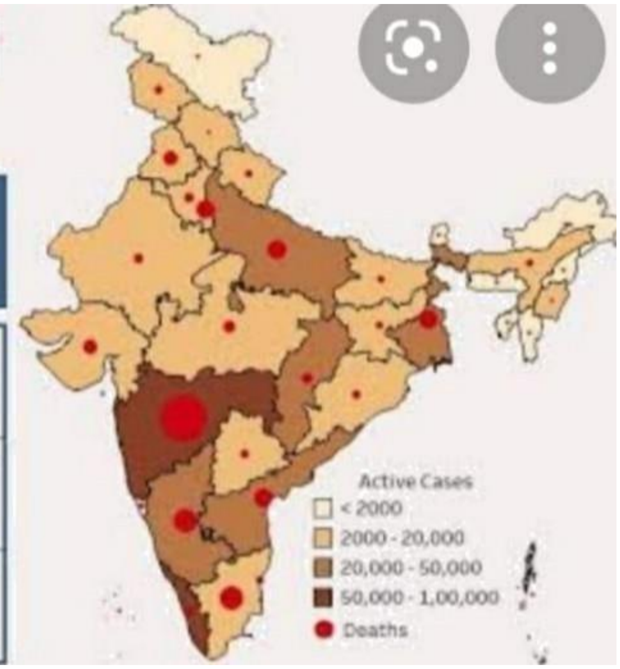
We can see that more number of COVID-19 clusters are in left half part of the India. In the North-East region of India ,despite being close to China , there are very less number of confirmed cases. The possible reason of this variation is discussed later part of this analysis.


Confirmed: 26496
Recovered : 5804
Deceased : 824
INDIA TV
indiatvnews.com
494 Jammu and Kashmir
Ladakh 20
28 Chandigarh
Himachal Pradesh 40
298 Punjab
Uttarakhand 48
289 Haryana
Delhi 2625
Meghalaya 12
Arunachal Pradesh 1
Rajasthan 2083
Uttar Pradesh 1793
Bihar 243
Nagaland 0
Assam 36
Manipur 2
Tripura 2
Mizoram 1
Gujarat 3071
Madhya Pradesh 2096
Jharkhand 67
West Bengal 611
Odisha 94
Maharashtra 7628
Telengana 991
Chhattisgarh 37
7 Goa
Andhra Pradesh 1061
500 Karnataka
Puducherry 7
Andaman and Nicobar Islands 33
Tamil Nadu 1821
457 Kerala

COVID-19 Tracker

As on 11 November 2020, till 8AM

Total Cases	86,36,011 (▲44,281)	
Recovered	80,13,783 (92.79%)	A50.326
Active	4,94,657 (5.73%)	▼6,557
Deaths	1,27,571 (1.48%)	▲512



States' Caasa (Highest)		Recovered (sc)	Active (ss)	Daatha (w)
Maharashtra	17,26,926 (A3,791)	15,88,091 (92%)	93,400 (5%)	45,435 (2.6%)
Karnataka	6.51.212 (A2.3G2)	8,08,700 (95%)	31,082 (4%)	11,430 (1.3%)
Andhra Pradesh	6,46,245 (A1666)	8,18,473 (97%)	20,958 (2%)	6,814 (0.8%)
Tamil Nadu	7,46,225 (AZ,146)	7,18,129 (96%)	18,709 (3%)	11,387 (1.5%)
Uttar Pradesh	5,01.311 (A2.112)	4,71,204 (94%)	22,846 (5%)	7,261 (1.4%)
Kerala	«.ss.zzz (16.010)	4,15,158 (84%)	78,812 (16%)	1,742 (0.4%)
Delhi	4.51.382 (A7,630)	4,02,854 (89%)	41,385 (9%)	7,143 (1.6%)
West Bengal	4,13,112 (A3.6s1)	3,72,265 (90%)	33,444 (8%)	7,403 (1.8%)
Odisha	3,03,760 (A967)	2,91,137 (96%)	11,189 (4%)	1,454 (0.5%)
Telangana	2,53,6S1 (A1,196)	2,34,234 (92%)	18,027 (7%)	1,390 (0.5%)
Bihar	2,23.34G (A4Z9)	2,16,097 (97%)	6,093 (3%)	1,156 (0.5%)
Rajasthan	2.15.071 (AI.902)	1,96,338 (91%)	16,725 (8%)	2,008 (0.9%)
Assam	2,09,388 (▲271)	2,02,471 (97%)	5,965 (3%)	952 (0.5%)
Chhattisgarh	2.04,m2 (*1c79)	1,80,995 (89%)	20,725 (10%)	2,482 (1.2%)
Haryana	1,87,777 (▲2,546)	1,68,421 (90%)	17,421 (9%)	1,935 (1.0%)
Gujarat	1.82.SS7 (A1,049)	1,66,331 (91%)	12,456 (7%)	3,770 (2.1%)
Madhya Pradesh	1,79,068 (▲900)			
Punjab	1,38,485 (▲486)	1,29,089 (93%)	5,038 (4%)	4,358 (3.1%)
Jharkhand	1,04,940 (▲252)			
Jammu & Kash..	9A844 (a492)	92,880 (93%)	5,415 (5%)	1,549 (1.6%)

Conclusion

Addressing the COVID-19 crisis, a locally valuable data resource utilising existing smart-city systems, IoT sensors, and Machine Learning was rapidly developed to provide timely insight into policy decisions as they played out in real-time. Four critical conclusions can be drawn from this: (1) the dashboard was realised due to longstanding trustrelationships built up between the UO team and local officials; (2) the infrastructure was already in place with sensors, data, and analysis capacity established/installed over the last 5 years; (3) capturing long-term data baselines and city metrics is critical to capture the interdependencies and linkages in complexsystems; and (4) COVID-19 has demonstrated there is a genuine demand for realtime data and analytics in a city context. Whilst these new forms of data from IoT and MLbased analytics certainly have their place in both COVID-19 response and recovery, and wider city governance and management, data is not a magic bullet that guarantees understanding and insight. Urban big data can provide a narrative and show something is happening, and even the magnitude of the effect, yet it can never truly capture the underlying cause–effect relationship. Understanding human behaviour at individual and collective levels is equally critical. Concern over privacy issues and surveillance societies must be balanced with the potential value of big-data analytics through transparency and governance of these new forms of data. As we struggle to find a personal and social response for the post-COVID-19 response, the integration of new forms of quantitative data coupled with analysis of the root causes of behaviour change could provide a lasting legacy and deeper understanding of urban science developments.

Data and access

The Newcastle UO COVID-19 dashboard can be found http://covid.view.urbanobservatory.ac.uk.

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